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METEOROLOGY.

METEOROLOGY AND THE SIGNAL SERVICE.

I.

The death of Gen. Myer, the late Chief of the Signal Service, and the necessity of providing a competent successor, have drawn public attention to the Signal Bureau and to the details of the organization.

The work of the Signal Corps during the late war is well known, but the manner in which the meteorological division of the service, as now constituted, came into existence and under control of the War Department, is not so generally known; and, as the paternity of the work is claimed by several persons, it is believed that the following compilation from official papers upon the subject will be of service in giving credit where it is properly due.

On December 8, 1869, Prof. I. A. Lapham, of Milwaukee, Wisconsin, who had been for years a persistent advocate of the importance of some national system of weather reports, in which the telegraph was to play an important part, addressed the following memorial to the Hon. H. E. Paine, member of the House of Representatives from Wisconsin. The memorial was accompanied by a list of disasters upon the lakes, making thirty pages of printed matter, of which the summary only is given in this paper:

MEMORIAL OF PROF. I. A. LAPHAM, OF MILWAUKEE, WIS.

"Not only does the interest of commerce and navigation, but also that of humanity itself, demand that something should be done, if possible, to prevent

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the fearful loss of life and property on our great lakes, such as has recently filled so many newspaper columns with their appalling details. If we could have even a few hours' notice of the approach of the great storms that bring these calamities upon us, much of their mischief might be avoided. The endeavor to predict the occurrence of storms has been attempted in England, by the late Captain Fitz-Roy, and in France, by LeVerrier, the astronomer; with what success will appear from the following extracts:

"On the 2d of December, 1863, during the day-time, I received two dispatches, stating that a severe storm was about to traverse France," writes the President of the Toulon Chamber of Commerce to M. LeVerrier; "they were published and posted up immediately, and the merchant vessels in the roadstead had time to provide, and did provide, against all risks. The maritime prefecture, on its behalf, directed all officers who were on shore to hasten on board their vessels. The storm burst forth with all its fury about half-past three o'clock in the afternoon. The first telegram sent on the 2d, confirming that of the day before, had therefore gained four hours' time ahead of the storm, and everything was ready to meet the emergency. *Thanks to the precautions thus taken*, there was no damage, no disaster to deplore."

The Genoese *Journal*, of December 3, says that "the prediction telegraphed by the Paris Observatory to Turin, and immediately communicated to the ports on the western coasts of Italy, on the 1st instant, was fully realized. The first signs of the storm were felt yesterday, about 7:30 p. m. During the night it raged furiously; but there appears, nevertheless, to have been no disastrous occurrence in our neighborhood. The commandant of the port had hastened to take all proper measures, and we may be thankful for them."

Prof. J. P. Espy, in his second report on meteorology, makes, among many others, the following "generalizations" from the observations made and collected up to the year 1850, the date of that report:

"Storms in the United States, travel from the west toward the east.

"They are accompanied with a depression of the barometer near the central line of the storm.

"They are generally of great length from north to south, and move side foremost toward the east.

"Their velocity is such that they travel from the Mississippi to the Connecticut River in about twenty-four hours, and from thence to St. John, Newfoundland, in nearly the same time, or thirty-six miles an hour; and

"The force of the wind is in proportion to the suddenness and greatness of the depression of the barometer."

Subsequent observations have fully confirmed the truthfulness of these important deductions, which may therefore be set down as established facts or principles in meteorological science. The storm of March 22, 1861, is known to have occupied eight hours in passing from Dubuque, on the Mississippi, to Milwaukee, on Lake Michigan.

XUM

Now, it is quite clear that, if we could have the services of a competent meteorologist at some suitable point on the lakes, with the aid of a sufficient corps of observers with compared instruments, at stations located every two or three hundred miles toward the west, and the co-operation of the telegraph companies, the origin and progress of these great storms could be fully traced; their their velocity and direction of motion could be ascertained; their destructive force and other characteristics noted—all in time to give warning of their probable effects upon the lakes.

Doubtless there would be failures, and mistakes made; and many experiments and repeated observations would be necessary before the system could be made to work with perfection. But is not the object sought of sufficient importance to justify such a sacrifice? If it should prove successful in even one case, it might be the means of saving property worth many times the cost of the experiment.

But how shall all this be accomplished, and who will assume the burden of its cost? Perhaps the establishment of a meteorological department of the Chicago Academy of Science, with a proper organization and a *sufficient endowment*, would be the most likely to secure the desired results. The money should come from those most likely to be benefited."

"MILWAUKEE, WIS., December 8, 1869.

DEAR SIR: I take the liberty of calling your attention to the accompanying list of disasters to the commerce of our great lakes during the past year, and to ask whether its appalling magnitude does not make it the duty of the government to see whether anything can be done to prevent at least some portion of this sad loss in future.

Yours, very truly,

I. A. LAPHAM."

Hon. H. E. PAINE, M. C.

OUR LAKE MARINE—RECORD OF DISASTERS FOR 1869—NUMBER OF DISASTERS REPORTED, 1,914—ESTIMATED DAMAGE TO PROPERTY, $4,100,000 —INTERESTING TABULAR STATEMENTS.

Navigation having practically closed for 1869, in accordance with our custom we lay before the readers of the *Sentinel* a record of the disasters which have been reported during the season. The list is very long, and the estimated damage to hulls and cargoes unusually heavy. According to our summary, the number of vessels which met with disaster is 1,914, against 1,164 last season—showing an increase of 750. In 1868, 103 vessels were totally wrecked, whose measurement aggregated 26,441 tons. This season the number totally lost is 126, with a measurement of 33,892 tons—which is certainly a large increase. Up to the 31st of October the amount of damage sustained by the shipping on the lakes was hardly equal to the average of seasons, and vessel owners and underwriters congratulated themselves upon their good fortune. But the storms of November, following in

quick succession, and each even more violent than the preceding one, swept away all these bright prospects and burdened both owners and underwriters with heavy losses. The disasters reported in November number 403, involving damage to property of upward of $2,000,000. These are probably the highest figures ever reached in any one month since the navigation of the lakes began. The loss of life during the season was considerably less than in 1868. The tables which complete our summary are valuable for future reference and should be preserved.

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RECAPITULATION AND COMPARISON.

	1869	1868
December, 1868	4	. .
January, 1869	1	1
February	4	. .
March	. .	. .
April	14	91
May	9	27
June	15	47
July	15	14
August	15	15
September	14	53
October	21	56
November	96	16
December	1	1
	209	321

This memorial was accompanied by the following bill: (R. H. 602.) which was introduced in the House of Representatives December 16th, 1869, by the Hon. H. E. Paine, and referred to the Committee on Commerce and ordered to be printed.

A BILL

To authorize the Secretary of War to provide for taking meteorological observations at the military stations in the interior of the continent, and for giving notice on the northern lakes and Atlantic seaboard of the approach and force of storms.

Whereas the record of marine disasters on the northern lakes for the years eighteen hundred and sixty-eight and eighteen hundred and sixty-nine, shows that during the year eighteen hundred and sixty-eight one thousand one hundred and sixty-four casualties occurred, involving a loss of three hundred and twenty-one lives, and of property of the value of three million one hundred and fourteen thousand dollars, and that during the year eighteen hundred and sixty-nine, one thousand nine hundred and fourteen casualties occurred, involving a loss of two

hundred and nine lives, and of the property of the value of four million one hundred and sixty thousand dollars; and that in eighteen hundred and sixty-eight one hundred and five vessels of the value of one million two hundred and seven thousand three hundred dollars were totally lost, and in eighteen hundred and sixty-nine, one hundred and twenty-six vessels of the value of one million four hundred and fourteen thousand two hundred dollars were totally lost; and whereas scientific observations have already shown that the course of storms in the United States is generally from west to east, and made known their rate of progress, and the changes of the barometer which precede and accompany them; and whereas a large proportion of the loss of life and property by marine disasters on the northern lakes might be avoided by timely notice to mariners of approaching storms; therefore,

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be authorized and required to take the necessary meteorological observations at the military stations in the interior of the continent and on the northern lakes, and to give notice on the lakes and Atlantic coast, by means of the electric telegraph, of the approach and force of storms.

Gen. Paine was strongly impressed with the importance of the subject, and requested an expression of views from the Surgeon General of the Army, Prof. Henry, Prof. Loomis, and from the Chief Signal Officer of the Army. The replies from these gentlemen were received and submitted to the House as follows:

WAR DEPARTMENT, SURGEON GENERAL'S OFFICE,
Washington, January 5, 1870.

SIR: I have the honor to state, in reply to your note of the 3d instant, that meteorological observations of barometer, thermometer, hygrometer, clearness of sky, and direction and force of winds, are now taken at all permanent military posts in the interior of the continent, as well as those on the seaboard and lakes. If means of rapid telegraphic communication with the most important points on the lakes and Atlantic seaboard could be secured, it would be entirely practicable for medical officers of the army, stationed in the interior, to give notice of the approach and force of storms passing from the direction of their respective stations.

I am, sir, very respectfully your obedient servant,

J. K. BARNES,
Surgeon General U. S. Army.

General H. E. PAINE, M. C.,
House of Representatives.

SMITHSONIAN INSTITUTION,
Washington, D. C., January 10, 1870.

DEAR SIR: Your letter asking my opinion of the practicability and merits of the proposition to establish, under the direction of the War Department, a system

of telegraphic dispatches to forecast the approach of storms, was duly received, but on account of a press of business and the late recess of Congress I have deferred my answer until to-day.

There can be no doubt from the present state of meteorological science that a properly devised and intelligently conducted system of weather telegrams would be of great importance to the welfare of commerce as well as of much interest to the general public.

The first application of the telegraph to the forecasting of the weather was in 1856, by the Smithsonian Institution, and was continued sufficiently long to test the practicability of the enterprise, and indeed, use was constantly made of it during the winter to determine as to advertising lectures at the Institution.

Systems of the kind are now in operation in England, France, Holland, Italy, and other countries, and are producing results of sufficient importance to justify their maintenance at the expense of the government. The Atlantic seaboard of the North American continent is much more favorably situated for receiving intelligence of approaching storms than the western coast of Europe, since, as a general rule, the storms that visit the latter coast are generated on the ocean, from which no telegraphic signals can be sent; while a large majority of those which prove disastrous to the shipping of our eastern coast, have their origin on the land, and moving eastward may consequently be telegraphed in advance to the principal commercial cities of the east.

In order, however, that this system may be of practical value, it is necessary that, 1st. The points from which the telegrams are to be sent must be carefully selected and furnished with reliable instruments. 2d. These instruments must be in charge of persons properly trained to make the observations. 3d. The telegrams must be transmitted regularly to some central point at fixed hours of the day. 4th. They must at this center be collated and their indications interpreted by persons having a competent knowledge of the laws to which the motions of the storms are subjected. 5th. I do not think the military posts as now established will be sufficient to carry out the plan; additional stations would be required. 6th. An appropriation would be necessary for the pay of the telegrams, furnishing the instruments, and the necessary superintendence.

The Smithsonian Institution has for twenty years been engaged in collecting observations in regard to the climate and changes of the weather on the continent of North America, and has now a number of persons employed in reducing and discussing the materials which have been collected. It receives at the end of every month the records of simultaneous observations, made over the whole of the United States by about four hundred observers, and from these the laws of the phenomena, so far as it is possible to determine them, will in due time be made out. The cost of the application, however, of these laws to practical purposes, must be defrayed by the government or by the community which is most interested in the results. I may, however, be allowed to add that any assistance

or suggestions which may be required in organizing the proposed system of weather telegrams will be cheerfully furnished by this institution.

I have the honor to be, your obedient servant,

JOSEPH HENRY.

Hon. H. E. PAINE,
House of Representatives.

YALE COLLEGE, January 10, 1870.

DEAR SIR: I have carefully read the memorial of Professor I. A. Lapham, recommending the establishment of a system of observations to give warning of the approach of violent storms, and heartily approve of the object of that memorial. It cannot be doubted that violent storms are subject to natural laws; that these laws have to some extent been discovered; and there is reason to believe that by patient investigation these laws may become still better known. One principle which has been derived by induction from a large number of cases is that over the United States violent storms do not long remain stationary in one locality, but travel from place to place; usually from west to east, or from southwest to northeast, and with a velocity varying from zero to forty miles per hour. What this direction is, and what is the velocity of its progress, can be ascertained in the case of any storm by a comparison of a sufficient number of recorded observations; and if every storm for a few years were tracked in this manner, the laws which they obey would become pretty well known. After these laws had been fully discovered, it would be possible, whenever a storm was raging, to give warning of its approach to places toward which the storm was advancing, several hours before its violence was actually experienced. If all violent storms come from the west or southwest, then by a system of combined observations it would be possible to give warning, at the port of New York, of the approach of every violent storm; and such warning would unquestionably be the means of preventing many disasters to the commerce of that port. It is believed that our knowledge of storms is already sufficiently precise to enable a competent meteorologist to furnish information which would be of great value to commerce, provided he had at his command a sufficient corps of observers scattered over a considerable area to the west and southwest, and also had the means of transmitting his warnings immediately by telegraph; and if such a system were pursued for several years, it could scarcely fail to conduct to more precise knowledge, which would render it possible to give more reliable and definite warning of the approach of dangerous storms.

In order to secure the objects here contemplated, it would be indispensable to have observations from a pretty large number of stations at intervals not exceeding one or two hundred miles, and scattered over a region to the west and southwest of those points for which the warnings were regarded as specially important. These observations should include all the meteorological instruments, but more particularly the barometer with the direction and force of the wind. The observations should be made daily at fixed hours, and should be

reported by telegraph to some competent meteorologist, whose business it should be to compare the reports without delay, and make the proper deductions from them, and whenever a violent storm was in progress, to decide in what direction and with what velocity it was traveling; determine what places it would visit, and at what hour it would arrive; and finally transmit the announcement immediately by telegraph to those places specially interested. Such a system could not be expected to attain satisfactory results without a pretty large number of well selected stations, and especially without the services of a competent meteorologist to superintend the entire system. The superintendent should be well informed respecting the progress which has been already made in this department of science —he should have strong faith in the practicability of attaining useful results by a system of storm-warnings; and he should have no other engagements which would prevent him from giving his whole attention to this subject, especially whenever a violent storm was raging in any part of the United States.

A system of meteorological observations has been for many years in progress under the direction of the Smithsonian Institution, and this system now covers a large portion of the United States. By combining a selected number of these observers with the observations at our military posts, the whole country might be covered with a net-work of observations which would be tolerably complete. I have great confidence that a general system of observations might be organized which would not only be of great value to science, but which would, in a few years (if not in the first year), give such increased security to commerce as would more than compensate for the necessary observations.

I am, with much respect, yours truly,

ELIAS LOOMIS.

Hon. HALBERT E. PAINE.

WAR DEPARTMENT,
OFFICE OF THE CHIEF SIGNAL OFFICER,
Washington, D. C., January 18, 1870.

SIR: I have examined with interest the bill you send me (H. R. 602), with the papers accompanying it, and I have submitted your communication to the honorable Secretary of War.

The subject of storm telegraphy had attracted my attention at the time of the heavy gales of the last fall upon the northern lakes—one of these gales was fully reported some hours in advance, and might have been telegraphed and signaled —and, by a coincidence, I had caused some maps, showing possible coast telegraphic and signal stations, to be arranged for the War Department, before the congressional papers reached me.

I have been much impressed with the importance of the endeavor proposed in the bill prepared by you, as an aid and safeguard to navigation, and as a mode not before availed of in this country, of utilizing, in the interests of commerce, the posts and force which must be maintained for military purposes in the interior and upon the sea coast.

No reason suggests itself to me to doubt that meteorological observations, sufficiently minute to be useful, can be made at different posts and points determined upon.

The transmission of such intelligence as is gained can be so systemized as to insure its certainty. Military posts are now scattered from the Pacific coast, throughout the interior, to the Atlantic. The branching lines of telegraph, increasing in number, are daily binding them more closely together, and bringing them in communicating range of the great business centers. Other points of observation and report could be established gradually. In time, even the ocean cables may be made to serve a part. Meteorological observations, statistics, and reports giving the presence, the course, and the extent of storms—the telegraph can announce their location, as stated, and their probable approach, as it would, in time of war, those of an enemy.

It seemed fair to conclude that, with experience, the direction and range of many storms could be foretold with reasonable accuracy. It is certain they might be in some instances. As I write this letter, I quote, as a commonplace illustration, a storm report I find in the Washington *Chronicle*, of this morning (Jan. 18), made as an item of newspaper news only, and probably without any care, concert, or haste as to its reporting.

ST. LOUIS, January 17.—A terrible storm of thunder and lightning, wind and hail, passed over the city *last evening*.

This was the evening of January 16.

CHICAGO, January 17.—During the thunder-storm *last night* the mercury stood at 42°.

This was the night of January 16.

LOUISVILLE, January 17.—A terrible tornado visited Cave City Station, on the Louisville and Nashville Railroad, at an early hour *this morning*.

This was the early morning of January 17.

CINCINNATI, January 17.—An unsually heavy storm of wind and hail, accompanied with thunder and lightning, occurred here *this morning*.

This was the morning of January 17.

PITTSBURG, January 17.—A heavy rain storm, and thunder and lightning, visited this place at *noon to-day*.

It is fair to presume that the storm of lightning, hail, and rain, the outskirts of which passed over Washington about six o'clock last evening (the evening of January 17), and was noticed by many as usual, was a part of this storm telegraphed at St. Louis on the evening of the 16th instant. If so, it could have been reported almost hourly in its course to this city.

A single storm report, wisely made upon the plan suggested by you, might save, perhaps, many times the cost of the experiment. Sufficient successes of organized systems of reports, having similar ends in view, in England, France, and on the shores of the Mediterranean, are already of record to warrant the endeavor on this side of the Atlantic, and, to suggest the thought, it would be

almost wrong to fail to make it in a country so extended and having such shipping interests as our own.

Such information of storms as could be gained, once received at chosen points, could be collated, posted, and announced in merchants' exchanges and to boards of trade in the principal seaport and lake cities, and plans of signals similar in effect to the coast-storm signals put in use some years ago on the coasts of England and France, shown on the seaboard forts and at selected stations, by men already in the employ of the United States, could communicate the possible danger to vessels passing in sight at sea or preparing for departure from their ports.

The brief examination I have been able to give the subject seems to show that, with forty-four sea-coast stations already owned by the United States, intelligence of value could be notified in this way by day or at night for the use of vessels in the vicinity of each of our prominent ports.

I do not doubt that the general plan of collecting and announcing storm reports you initiate, well executed, with the extended knowledge and improvement to which it would lead, would save, in frequent instances, both life and property. The measure, once placed by enactment in some organized form, will grow in importance. Insurance companies, boards of trade, and commercial bodies, and shippers will be prompt to see the attempted benefit, and give it the aid of their co-operation. I hope the bill, or one having the same ends in view, will become a law, and I think the results to follow its passage, though they may not be at once attained, nor had without time, labor, and trouble, will be gratefully appreciated by the commercial world.

I am, sir, very respectfully, your obedient servant,

ALBERT J. MYER,
Brevet Brigadier General and Chief Signal Officer of the Army.

Hon. HALBERT E. PAINE,
House of Representatives, Washington, D. C.

The letter of the Chief Signal Officer led to a personal interview with Gen. Paine, and the substitution of the following joint resolution for the bill as originally drawn and presented:

JOINT RESOLUTION

To authorize the Secretary of War to provide for taking meteorological observations at the military stations and other points in the interior of the continent, and for giving notice on the northern lakes and seaboard of the approach and force of storms.

Be it resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he hereby is, authorized and required to provide for taking meteorological observations at the military stations in the interior of the continent, and at other points in the States and Territories of the United States, and for giving notice on the northern lakes

and seaboard, by magnetic telegraph and marine signals, of the approach and force of storms.

This joint resolution was introduced February 2, 1870, by Gen. Paine, who asked and obtained its immediate consideration and passage.

It reached the Senate the same day, and was referred to the Committee on Military Affairs, which reported it back without amendment, through its chairman, Mr. Wilson, of Mass., on February 4th. It was passed by the Senate without opposition, and became a law through the President's approval, February 9, 1870.

On February 28, 1870, the Chief Signal Officer was informed by the Secretary of War that he was charged with the duties to arise under the provisions of the law, subject to the general supervision of the War Department.

In August, 1870, a small pamphlet was issued from the Signal Office, entitled.

GOVERNMENT TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE,

from which the following extracts are made, as illustrative of the preliminary work of the signal office in the establishment of the new service:

"Popular attention is at this time directed to the formal undertaking, for the first time on this continent, under Government auspices, of an organized system of weather reports to be made by telegraph, with the purpose of giving information in advance of the approach and force of storms for the benefit of commerce on the northern lakes and seaboard. The advantages to be gained, if success can be had, are so vast, and popular curiosity in reference to the subject is so general, that a brief statement of what has been undertaken in this regard in other countries, and of the steps which have led to the present action in our own, is thought worthy of publication.

"The special characteristic of modern efforts, in the development of meteorological science, consists in co-operation among observers laboring in different fields, and thus securing the data for determining the simultaneous condition of the atmosphere over extended regions of country.

"It is only by this means that the laws which govern the occurrence, motion, direction and propagation of atmospheric disturbances can be ascertained. As soon as this truth was recognized and acted upon, the important fact was developed that storms moved in certain fixed directions, and at such rates of speed as permitted telegraphic notice of their approach to be given to places lying in their paths.

"The practicability of utilizing this knowledge for the benefit of the commercial interest became at once apparent, and resulted in the organization of systems of storm warnings in several of the European countries most interested in maritime affairs.

"To the late Admiral Fitz-Roy, of the British Navy, belongs the honor of having been the first to put in operation a practical system of weather forecasts and

storm signals, based on deductions made from numerous observations received by telegraph daily, at a central point.

"The first cautionary or storm-warning signals were made in England in February, 1861, and in August of the same year published forecasts of the weather were tried with such success, that by the spring of 1862 sufficient experience had been gained to justify the adoption of the system still in use.

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"The value of the forecasts given is shown in a statement made by General Sabine to the Board of Trade. He says that he had examined the warnings given during the two years ending 31st of March, 1865, and found that in the first year fifty per cent. and in the second year seventy three per cent. were right. Warnings of storms were sent by Admiral Fitz-Roy to the north and west coasts of France, and from comparison with the records for the two winters of 1864–65 and 1865–66 it appears that of one hundred warnings sent during the first of these winters seventy-one were realized, and during the second winter seventy-six; and out of one hundred storms which occurred, eighty-nine were signaled during the first winter and ninety-four during the second winter.

"In 1861 the Imperial Observatory of Paris commenced publishing, in the form of a daily bulletin, weather reports from different points in France, which proved so interesting to the scientific world, and useful to navigation, that the system was extended throughout Europe, reports from each principal city being received daily in Paris, where they are discussed and the results transmitted by mail to all parts of the world in the successive numbers of the International Bulleletin. In 1863, the Observatory added to the bulletin a lithographic outline map of Europe, upon which diagrams are drawn, showing the barometric curve of the previous day through the various stations reporting, together with the temperature and direction and force of the wind, so that one can see at a glance the condition of the atmosphere as it was all over Europe the day before.

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"In carrying out this system of observations, France has been divided into districts, each consisting of a department, and in charge of a competent superintendent. By this arrangement much valuable material has been collected and many useful rules issued for the guidance of the agricultural community.

"In Russia, a system of meteorological observations bas been established, forming a net-work of stations throughout the empire, from which simultaneous daily reports are made to St. Petersburg, where they are collected and published for the benefit of commerce, and distributed throughout Europe.

"In Italy a similar system has been in operation for some years, and valuable reports are also made from Holland, Austria, and Norway, but not issued daily in the bulletin form.

"In Austria alone, one hundred and eighteen stations are reported where observations are taken by scientific men, who labor without remuneration and the results of whose labors are annually published by the Government.

"In Germany and Denmark, where the telegraphs are under Government control, telegraphic announcement of the approach of storms is sent to all seaports by the operators who are especially charged with the performance of this duty.

"The importance of regular meteorological reports was early recognized in this country, for the Medical Department, United States army, commenced taking observations in 1819. The States of New York, Pennsylvania, and Ohio followed in 1825, 1837, and 1842, respectively, and the Smithsonian reports in 1849. The observations, while valuable to the scientific world as studies for future application, or in reference to the sanitary condition of localities, were at first of no immediate benefit, and it was only when the introduction of the telegraph made their rapid transmission possible that attention was drawn to the possibility of practical storm warnings. In 1857 the Smithsonian Institution in Washington was in the daily receipt of weather telegrams, transmitted gratuitously by the telegraph companies, from various places east of the Mississippi and as far north as New York, and published in the Washington *Evening Star*. In 1858 a map was hung up in the Institution, on which was shown daily the changes of weather reported by telegraph from different parts of the country. Reference was frequently made by Professor Henry and the able correspondents of the Institute to the practicability of more extended plans of this description.

"In the same year the American Association for the Advancement of Science appointed a committee for the organization of a national system of meteorological observations, and a plan was presented, which provided for the appointment of a superintendent in each State, who was to collect and collate all observations within its boundaries, and forward them monthly to Washington. The expense of maintaining such a system was to be borne by the different States. No action was taken in the matter, however, and the daily publication of reports of the Smithsonian continued until the breaking out of the war in 1861, when it was suspended, but renewed again temporarily in 1862; but finally discontinued, owing to the cessation of observations in the southwest, and the constant use by the Government of the telegraph lines. In 1863 the newly appointed Commissioner of Agriculture commenced the monthly publication of a bulletin, giving the state of the weather and condition of the crops throughout the country from data furnished by correspondents. This publication is still continued, and is of value to the agricultural interests of the country. In 1869 a daily bulletin of the weather was published for three months in Cincinnati, Ohio, under the direction of Professor Cleveland Abbe, and the experiment proved so successful that it was renewed during the present year. Since 1863 several persons have endeavored to get congressional assistance in organizing the national system suggested by the Association in 1858. Mr. A. Watson, of Washington, has been earnest in advocating in the papers a system of storm signals for the benefit of agriculture.

"Professor I. A. Lapham, LL. D., of Milwaukee, has been a persistent and successful advocate of the importance of some national system of weather reports, in which the telegraph was to play an important part, and he brought powerful

arguments to bear in the shape of statistics, showing the loss of shipping on our lakes alone for a series of years. His views were brought strongly to the notice of Congress in 1869, in a memorial replete with interest. By a coincidence, papers and maps in reference to the same subject were prepared in the War Department at the time the memorial was submitted.

The matter was finally brought to the attention of Congress by the Hon. H. E. Paine, of Wisconsin, who offered the joint resolution which became a law on the 9th of February, 1870.

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The fact that in the north temperate zone storms almost invariably come from some westerly point, and follow an easterly course, renders the application of storm warnings in the United States of more immediate utility than in Europe, where the principal points, being on the eastern coast, are first affected by the storms. Here, as soon as a storm appears in the territory bordering the Rocky Mountains, it becomes possible, in many cases, with proper arrangements, to telegraph its approach to eastern cities in time to enable preparations being made against its destructive influence. It is not absolutely necessary that the observers or reporters should be scientific men, though the higher their grade of education the better, but that they should promptly announce the existence of a storm, with other meteorological facts, to the places lying within its probable path. It is essential they should be held to a proper responsibility, and be under strict official control. The form of report must be carefully devised and regulated. A series of reports of this kind will make possible in time the mapping out of each individual storm, and from this material can be deduced some general laws governing their movement. For example, the great storm of March 13–17, 1859, was thus mapped out by Professor Lapham, and its course found to run from western Texas, where it first struck our coast, in a northeast direction, to Lake Michigan, which it reached in twenty-four hours, thence to the Atlantic coast in another twenty-four hours, and finally leaving the continent at St. Johns, Newfoundland, in ninety-six hours after its first announcement. Here was a regular movement about as rapid as a railroad train, and as easily kept under supervision.

In a memorial to the Forty-First Congress, Professor Lapham says: "If we could have even a few hours' notice of the approach of the great storms that bring these calamities upon us, much of their mischief might be avoided."

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"It is quite clear," writes an eminent meteorologist, referring to these and other premonitions seemingly established by meteorological statistics, "that if we could have the services of a competent meteorologist at some suitable point on the lakes, with the aid of a sufficient corps of observers, with compared instruments, at stations located every two or three hundred miles toward the west, and the co-operation of the telegraph companies, the origin and progress of these great storms could be fully traced; their velocity and direction of motion ascertained; their destructive force and other characteristics noted, all in time to give warning of their probable effect upon the lakes."

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It must be remembered, however, that "there may be failures and mistakes made; and many experiments and repeated observations may be necessary before the system can be brought to work with perfection; but is not the object sought of sufficient importance to justify such a sacrifice? If it should prove successful in even one case, it might be the means of saving property worth many times the cost of the experiment."

It should not be allowed to escape attention, that while such generalizations as those above are held by many of the wisest and most careful meteorologists, there are those of much research who have different views. The absolute truth, it seems, will be arrived at only when careful, systematic, and official observations shall have done away with many causes of error and difficulties in the way of truthful deductions which such observations solely can remove.

The system inaugurated by Congress is designed for the protection of the seaboard as well as the lake districts. It is hoped to extend its benefits to all the coasts and, by the necessary stations, to the great navigable rivers of the United States.

The plan so far determined upon by the War Department contemplates the simultaneous observation of atmospheric phenomena, the telegraphic transmission of reports of these observations, and the wide-spread publication of the reports at all points where they will be of service to the commercial interests of the country. What is proposed in the present and contemplated in the future is clearly stated in the following "memorandum," issued from the department in Washington charged with the performance of the duty:

1. *Observation and Report of Atmospheric Phenomena.*

a. A series of meteorological observations and reports will be made by careful observers under military control, and supplied with the best attainable instruments. All instruments will be adjusted to a standard at Washington.

b. The observers will be stationed at points throughout the United States, selected by competent authority, as those from which reports of observations will be most useful, as indicating the general condition of the atmosphere, or the approach and force of storms.

It has been in view to so locate these stations that, the existence of a storm at one or more of them being determined, information of the facts may be had by the regular reports communicated by telegraph in advance of its probable movement.

c. Synchronous observations will be taken, and reports made from the stations three times a day, one about 8 a. m., one about 6 p. m., and one at midnight. These observations and reports will be timed by Washington time. The office is in a measure led to this selection of hours by the press of business at other times upon the telegraphic lines. Other observations will be made for record.

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2. *Transmission of Reports.*

a. The reports of observations are to be transmitted by telegraph, under a special arrangement with the telegraph companies whose lines connect the different points where stations will be established.

b. By a combination of telegraphic circuits, the reports of observations made at different points synchronously will be rapidly transmitted to the different cities at which they are to be published. They will also be concentrated at Washington. The whole time required to transmit, collate, and deliver the reports, from the extreme points of observation to the points of publication, will, it is hoped, not exceed one hour.

3. *Publication of Reports.*

a. It is intended to give the widest publicity to these reports, in order to make them useful to the greatest number. Copies of all reports will be furnished to the different papers for publication, and each report will be bulletined in the board of trade rooms, merchants' exchanges, or other conspicuous places, immediately upon its receipt.

b. So soon as the necessary arrangemements can be had, a meteorological map on which the changes can be noted as each report is received, will be displayed a the board of trade rooms, or other business centers in each city receiving reports. Similar maps will be furnished the different scientific establishments cooperating with the department.

c. The reports will be limited at the outside to the simple statement of meteorological facts existing at the stations of observations. These facts, together with such general laws as seem to have been determined by meteorological observations hitherto made and as may permit probable deductions to be made from the reports, will be published.

d. It is not deemed advisable to attempt at the outset, further than in this way, predictions which must often be erroneous.

e. Whenever experience has certainly determined what may be regarded for any section of country as premonitions of approaching storms, signal-stations will be established as quickly as the necessary arrangements can be made, and signals will be displayed announcing their probable approach, with other information which may be possible.

f. The observer, when one is stationed in any city, will be constantly on duty during business hours, and every facility will be given to obtain copies of the bulletins, or other full and the latest information.

4. *Stations.*

The following have been designated as stations of observation and report, or of report alone, and will be occupied as rapidly as arrangements can be effected:

Plaister Cove, N. S.; St. Johns, N. B.; Portland, Me.; Boston, Mass.; New Haven, Conn.; New York City, N. Y.; Philadelphia, Pa.; Baltimore, Md., Wash-

ington, D.C.; Wilmington, N. C., Charleston, S. C.; Augusta, Ga.; Savannah, Ga.; Lake City, Fla.; Key West, Fla.; Montgomery, Ala.; Mobile, Ala.; New Orleans, La.; Jackson. Miss.; Memphis, Tenn.; Nashville, Tenn.; Louisville, Ky.; Cincinnati, Ohio.; Knoxville, Tenn.; Albany, N. Y.; Syracuse, N. Y.; Oswego, N. Y.; Rochester, N. Y.; Buffalo, N. Y., Cleveland, Ohio; Toledo, Ohio; Detroit, Mich.; Chicago, Ill.; Indianapolis, Ind.; St. Louis, Mo.; Milwaukee, Wis.; St. Paul, Minn.; Duluth, Minn.; Omaha, Neb.; Cheyenne, Dak.; Corinne, Utah.; Santa Fe, N. M.; Fort Benton, N. M., San Francisco, Cal.; Pittsburg, Pa.

The staff of the signal office during the year 1870 and 1871, covering the period of organization, was composed of the following named officers:

First Lt. L. B. Norton, Property and Disbursing officer, detailed April 7, 1865, died, December 23d. 1871. Succeeded by 1st. Lt. Henry Jackson, who remained until August 12, 1876.

Second Lt. H. W. Howgate, in charge of stations, detailed April 18, 1868, and who is still on duty.

Capt. C. M. Pyne, Adjutant, detailed April 16, 1870, relieved December 15 1870 and succeeded by Capt. Garrick Mallery, who remained until August 17, 1876.

In November 1870, Prof. Lapham, of Milwaukee, was employed as civilian assistant to the Chief Signal Officer and stationed at Chicago, with special reference to the supervision of the Signal Service on the lakes.

The services of Prof. Cleveland Abbe, were secured January 3, 1871, since which date he has remained on duty in the Signal Office.

Prof. Thompson B. Maury, entered upon service as assistant to the Chief Signal Office June 18, 1871, and remained until his resignation on November 30 1875.

First Lt. Robert Craig, was detailed February 1, 1871, and 2d. Lt. A. W. Greeley, July 6, 1871, and both officers were employed during the year upon the studies and preparation of the charts and papers necessary to fit them for duties in connection with this service.

On November 1, 1870, at 7.35 a. m., the first systematized synchronous meteoric reports ever taken in the United States were read from the instruments by the observer-sergeants of the signal service at twenty-four stations, and placed upon the telegraphic wires for transmission.

With the delivery of these reports at Washington, and at other cities and ports to which it had been arranged they should be sent, which delivery was made by 9 a. m., commenced the practical working of this division of the signal service in this country.

On the first day of report the tabular bulletin reports were bulletined and furnished at twenty- four cities. The organization and instructions seem to have been sufficiently minute to guard against accident or error.

The issue of synopses and probabilities, as they are styled, was commenced by the office on February 19, 1871, and has been made thrice daily since that date.

The synopses consist of a synoptic view of the meteoric condition of the United States, collected from the data received at each regular report.

The probabilities are the deductions made by the office, from the data in its possession at the time of each report, as to the meteoric conditions probably to occur during the ensuing eight hours.

The following extracts are from a report made from Professor I. A Lapham to the Chief Signal Office, January 16, 1871:

"All papers, reports and instruments were placed subject to my inspection, and all facilities were directed to be afforded me in the discharge of these duties. My instructions were to furnish daily to the Chief Signal Officer for his consideration, as quickly as possible after receiving the morning reports, a brief sketch of the reports received for the twenty-four hours preceding (or for a longer period), as to facts bearing upon the probable weather, with a statement of the probable character of the weather for the next twenty-four hours; and in case of imminent danger the dispatches were to be immediately published along the lakes by the several observers, without awaiting orders from the Chief Signal Officer.

In the prosecution of this work I have had occasion to suggest certain changes and improvements in the methods of doing this important work in hand, some of which have been adopted and have resulted in saving the time of the observers and of securing greater accuracy of results.

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"In compliance with these instructions I proceeded each morning, with as little delay as possible, to construct a skeleton chart of the matter on a large sheet of paper, upon which the relative positions of the several stations had been marked, showing the height of the barometer above or below the mean (announced to be thirty inches), the state of the matter, the temperature, the direction and velocity of the wind, etc., at the several stations from which reports were received. These items were so connected by lines (in different colors) as to show the districts where the barometer and the temperature were high or low, when rain or snow was falling, etc., thus representing to the eye in a comprehensive manner the condition of the weather over the whole country, from the Atlantic to the Rocky Mountains, and from the Gulf of Mexico to the great Northern Lakes.

With the aid of the meteorological chart and the column showing the amount of change since the last preceding report, and with a general knowledge of the character and movement of storms over the interior of our continent, we can readily determine what predictions to send forward.

Comparing one of these with the next preceding, the progress of weather changes as they move over the country can at once be seen, and their direction and velocity ascertained.

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The first dispatch of the signal service sent from Chicago was dated at noon on the 8th of November, 1870.

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A glance at the skeleton-charts daily prepared to show the meteorological phenomena more readily to the eye, shows the magnificent extent of the atmospheric distances that then follow each other with such rapidity over the country. The several lines of equal barometic pressure seldom inclose a space within the region covered by the stations. * * *

These lines are mostly in the form of curves of very great radius. * * Such far-spreading phenomena can surely not be produced by any local changes of temperature." * * *

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These extracts are interesting as showing the first steps taken by the Signal Service in the discussion of weather reports, the preparation of charts and the issue of forecasts.

They also furnish valuable data in reference to the question of priority among the numerous applicants for the honor of originating the present system of weather work of the Signal Service.

On January 1, 1874, in pursuance of an arrangement between Professor Henry and the Chief Signal Officer, the very extensive system of meteorological reports made by volunteer observers throughout the United States, under the supervision of the Smithsonian Institute, was transferred to the charge of the Signal Office.

On June 19, 1874, the series of meteorological observations made at military posts and stations throughout the United States, were transferred to the Signal Office by the Surgeon General of the Army, thus concentrating the official meteorological work of the country in one office and under one management, where it has since remained.

CLOUDS.

PROF. S. A. MAXWELL, MORRISON, ILL.

Clouds are masses of aqueous vapor condensed to such an extent by a diminution of temperature as to become visible. A given quantity of air will remain transparent so long as it is capable of absorbing watery vapor, and when it can absorb no more, it is said to be *saturated.* Even in this condition it is quite transparent; but if from any cause the temperature is lowered, a portion of the moisture is condensed, forming minute, though visible, vesicles of vapor, such as are seen floating in the air during a fog. These vesicles are hollow spherules sufficiently opaque to render the clouds which they form able to exclude the sun's rays either wholly or in part. The temperature of a saturated portion of air may be diminished in two ways—a cold current of air may enter it, or it may itself rise into a higher and colder stratum. The result of either of these conditions is usually the formation of clouds; and all or nearly all precipitation is due to the cooling of ascending currents at a vast height.

There are seven distinct varieties of clouds, arranged in two groups, known as primary and secondary. The primary group embraces the varieties called cumulus, stratus, cirrus, and nimbus; the secondary, the forms designated cirro-cumulus, cirro-stratus and cumulo-stratus. This classification is quite faulty, as the words primary and secondary are not used in their true meaning. The word *primary* signifies pertaining to the first, hence *primary clouds* ought to mean the original or first forms of clouds—those forms which they assume at the beginning of their existence. Now, of the four varieties styled "*primary clouds*," but two, the stratus and the cumulus, can properly be called primary, as they only are original forms. A better classification is as follows:

CLOUDS.
- I. Primary or Original.
  - *a.* Stratus.
  - *b.* Cumulus.
- II. Secondary or Transformed.
  - *c.* Cumulo-stratus.
  - *d.* Nimbus.
  - *e.* Cirro-stratus.
  - *f.* Cirro-cumulus.
  - *g.* Cirrus.

The processes of cloud formation and transformation are easily understood if we are sufficiently observing. The manner in which primary clouds originate has been briefly stated already, or rather that part of the subject relative to the formation of the cumuli—an interesting phenomenon which may be witnessed during the forenoon of almost any day in summer. The name, stratus, is applied to that form of cloud which often floats near the surface of the earth after a heavy rain-storm, also to those with which, in autumn and winter the entire heavens are often obscured. A third though less common form of the stratus is sometimes seen during the evening of the cooler days of summer, and is caused by the settling of cumuli to lower strata of air. The lower portion of a cloud when approaching the earth in this manner, is usually changed to invisible vapor, the air which it enters being warmer and consequently more capable of holding moisture. The rounded or conical form of the cumulus is by this means made to resemble the stratus, and after a short time, a perfect form of the latter will be produced by lateral expansion caused by gravity. This form of the stratus is short-lived, never being converted into any other kind of cloud—but is soon dissipated into invisible vapor. That form of the stratus which is often seen just after a heavy rain (particularly if the latter be followed by a strong east or south-east wind), is produced when the lower stratum of air is, in its parts nearest the earth's surface, too warm to be in a saturated condition, while at an elevation of a few hundred yards the temperature is so low as to cause the vapor to condense. When this phenomenon occurs there are usually two strata of clouds, one moving diametrically opposite or at right angles to the other. This form of the stratus is an original cloud while that previously described is a modification of the cumulus. The direction taken by these clouds, is one of the best of weather indicators.

If, after a storm, they move *toward* the north-west, another storm is almost sure to follow. This circumstance generally indicates a large area of "low barometer," the center of which is still to the westward of the place of observation. If on the contrary, these stratus clouds move *from* the west or north-west, it indicates rising barometer, fair weather and lowering of temperature. It takes comparatively little experience in weather observation, for one to foretell the weather with tolerable accuracy whenever these clouds appear. The stratus is never transformed into the nimbus as some meteorologists have supposed. It is true that mist sometimes falls from these clouds, but even then there is so wide a difference between them and true rain-clouds—both in form and origin—that it appears unscientific to consider them rain-clouds. One reason why some have supposed that these forms yield rain or are transformed into rain-clouds, is doubtless due to the fact that the heavens being sometimes over-spread with them, rain begins to fall and continues to do so for a considerable time and in large quantities. The truth is simply this—the stratus floats low and obscures the storm-cloud which is at a much greater altitude. The rain falls *through* the stratus; not *from* it—the rain-drops beginning their descent from points varying in elevation from two to ten times that of the base of the lower (stratus) cloud. This feature was particularly noticeable on the occasion of the great storm which passed over large portions of Iowa and Illinois on July 1st 1878.

The stratus more than any other form of cloud, has the power of absorbing light, or in other words it is a poor reflector. For this reason it always has a dark color, though its base is usually less dark than that of the cumulus. It is more uniform in color than the cumulus, while its edges are less sharply defined both of which facts are due to the difference in their densities.

Let us now consider the cumulus. This is truly the cloud of day, its typical form never appearing in our latitude in the night, unless the weather is very warm for the season. The word *cumulus*, signifies a *heap*, and is therefore definitive; giving a very good idea of the form of the cloud. These clouds are formed chiefly during the forenoon of warm days of spring and summer by the condensation of the vapor contained in ascending currents of air. They attain their greatest height during the hottest portions of the day; at which time according to Flammarion, they are 10,000 feet above the surface of the earth. In fair weather their thickness is rarely more than 2,000 feet, though no figures can be given as even approximately correct at *all* times; for latitude and temperature greatly modify both their dimensions and their altitude.

The cumulus, proper, is always an *original cloud*, by which is meant one formed directly from invisible vapor. Its base has a dark or black color, but the portions illuminated by the sun are of a beautiful white, sometimes changing to a yellowish or ruddy tint—to the former when there is much moisture in the intervening air, and to the latter when the air is filled with smoke or the so-called dry-fog, characteristic of Indian summer. No cloud possesses more beauty than this

—its clearly cut outlines and exquisite tints contrasting so admirably with the deep blue of the sky.

For this reason artists attempt its representation in their paintings, but commonly in a very imperfect manner, nature in this instance, defying Art with persistence and success.

The cumulus generally floats in the surface stratum of air. This can be verified by simple observation, the vane generally points *toward* the direction from which these clouds move. It is the cumulus which so often furnishes the temporary but refreshing shade to the weary out-door laborer, the severity of whose task is thereby greatly mitigated. It is the function of the cumuli to act as watetr-carriers, and in this capacity is their chief merit found. Millions of tons of water are daily conveyed in this manner with the speed of an express train from one portion of the country to another. Sometimes this water falls as rain and sometimes the clouds which it forms are dispersed and become again invisible vapor.

The two forms of clouds known as cumulo-stratus and nimbus, are but the cumuli in its more advanced stages of existence. When there is *low* barometer with high temperature, the cumuli instead of dispersing, congregate in vast masses, sometimes disposed in ranges resembling mountains with domes and peaks rising grandly against the background of the sky. These clouds rise to an immense height, their summits frequently being 25,000 feet from the surface of the earth. Their bases vary in elevation from 3,000 to 5,000 feet, consequently, their vertical thickness is very great. The apex of a thunder-cloud in hot weather, can be seen frequently on our western prairies, at a distance of two hundred miles.—This fact can be proved almost any summer's day by means of the telegraph.

In treating of *causes* we necessarily touch upon their *effects*, hence in speaking of clouds we must speak also of the phenomenon of precipitation. Meteorologists hold different views concerning the direct causes which produce rain. Rozet and Kaemtz hold that, it is due to the commingling of cirrus and cumulus clouds; the former being composed of frozen and the latter of vesicular vapor.

Now, I do not regard the cirrus as a *cause* of rain so much as an *effect*. The cirrus if I may so term it, is the ashes of the storm cloud, being only an incidental product of the storm. If one of those scientists of Germany or France, who upholds the theory of Rozet, would spend one summer on our western prairies, he might see more than a dozen storms originate without a vestige of one of the cirri present in the visible heavens. It is a fact, however, that very soon after a cloud begins to yield rain, it assumes the so-called "carded appearance" on its almost vertical sides and as the top becomes smooth a small horizontal fan of cirrus or cirro-stratus proceeds from near the summit gradually expanding laterally and in front until it covers manyfold more territory than the true rain cloud from which it was developed. If our scientific friend should continue his observations of this shower, he might possibly have the privilege of witnessing how "storms die," for after the moisture of the cloud has mostly fallen as rain, he will notice the lower parts dwindling away, until by and by there will be no more "streaks of rain"

under the cloud, and all semblance to the original cumulus or later nimbus will have disappeared—all that remains being a flat cloud, a true cirrus or cirro-stratus, which may dissolve in a short time and leave no trace of the storm or shower to which it once belonged. I have seen many instances of all these transformations, from cumulus to nimbus, from nimbus to cirro-stratus, from cirro-stratus to cirrus, and often the time required for these changes did not exceed an hour. It is much more common for the cirro-stratus to exist for several, hours then change to the cirrus in which form it will float for days, moving in an easterly direction, at an immense height. The little white films of cirri, which pass over us nearly every day, especially in hot, dry weather, are the ashes of storm-clouds whose force was spent on the peaks of the Rocky mountains, or possibly on the briny waves of the distant Pacific.

The ascending currents which form the cumuli and carry them to great heights, sometimes impart to them sufficient inertia to cause their entrance into currents of air having a temperature considerably below 32° Fah. When this takes place vesicles of vapor in the upper portions of the cloud become suddenly converted into buoyant frost-crystals, many of which speed away on the wings of the wind—the cold current moving much more rapidly than that containing the lower portions of the cloud. A large number of these frost-crystals and spherules of ice, descend into the lower and denser portions of the cloud, diminishing its temperature, thereby tending to produce precipitation; and no doubt in many instances rain does result from these conditions; though a far greater amount is caused by the cooling of ascending currents of humid air.

With regard to their *direction* of *motion*, clouds must, of course, take the direction of the current of air in which they float. In the different parts of the earth the direction of the prevailing wind varies. The direction of the cumulus and the stratus will usually be the same as the surface wind, while the direction taken by the other forms, is more or less independent of it. Of these the cumulo-stratus and nimbus, being formed from the cumulus, usually (at least during the day-time) take the direction of the surface wind; but the cirro-stratus and cirrus almost invariably move in an an easterly direction.

The cumulus, proper, as stated heretofore, is an original form of cloud, but there is occasionally a cloud which greatly resembles it, though it is a transformation. The cirro-stratus is a frozen cloud but sometimes becomes reduced to vesicular vapor, and soon after it collects into little, rounded, fleecy masses called cirro-cumuli. When this process continues for a considerable time all the distinguishing characteristics of the cirro-stratus will become obliterated, and the cloud assumes the exact appearance of the cumulus. It never attains very great size and owing to its immense height, appears almost motionless. It forms only in hot weather; and is quite often the harbinger of a storm.

The velocity with which clouds move depends mainly upon the velocity of the air-current in which they are suspended. The force of gravitation has a tendency to bring scattered clouds together; and when they have a common altitude,

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this is frequently the result. A large cloud obtains great additions to its volume in this manner—the small ones in its vicinity being gradually incorporated with it. I have observed this phenomenon more especially in the cumulus, and its derivative, the cumulo-stratus. It is obvious that this mutual attraction would in some cases accelerate and in others retard the motion of clouds; yet, in no case would the effect be visibly perceptible. The velocity of clouds may often be very closely determined by noting the rate of speed with which their shadows move. The lower clouds which appear to move so very rapidly, frequently have a slower rate of speed than those apparently motionless ones far above them. This, of course, is due to the fact that the latter are from ten to twenty times more distant.

Though the clouds are classified and the different forms named, it is nevertheless true, that at certain seasons of the year, the typical forms are rarely seen in our latitude. It is a fact worth noticing that the rain storms of winter, in the northern parts of the United States are *not local showers*, but nearly all are great storms several hundred miles in extent, originating in a warmer latitude where the cumuli are the common day clouds in winter as in summer. The cumuli are germs of rain-clouds, hence, where the former do not exist, the latter will not originate,

It is not varying temperature alone that causes clouds to assume other than typical forms. As has been observed, there are frequent transformations, as the cumulus to the stratus, or the cirro-stratus to cirrus, therefore there is an infinite varietyof transitional forms, which are classed among those with which they bear theclosest resemblance.

The study of clouds is of much importance. If in this brief article enough has been said to stimulate some thoughtful mind to examine into it still further and bring to light some more of the truths of science, the chief object of the writer will be accomplished.

To persons of æsthetic natures the study of the clouds is particularly delightful. Poets in all ages have adorned their verse with similes in which "the clouds" have constituted one element of the comparison. The same idea of cloud-beauty has often been used by the orator on the rostrum, and the divine in the sacred desk, when they wished to adorn their speech with a jewel of metaphor.

A better knowledge of the science of meteorology is developing among the people of our country; and this is due in part to the efficient management of our Signal Service Bureau, and in part to the publication of numerous well-written articles on the subject by observers in different sections of our country. It is to be regretted that so many statements (in reference to atmospheric phenomena) found in popular text books, should be so far from the truth as they are. That such errors should exist, is to be expected, since daylight has but just dawned in the science of meteorology. But it is encouraging to know that the misty theories founded on ignorance and conjecture are rapidly giving place to those established by a careful study of the effects produced by the operation of natural laws.

MORRISON, Ill., Oct. 16, 1880.

GEOGRAPHY.

THE SURVEY OF WESTERN PALESTINE.

The Palestine exploration fund has just issued the first installment of the published results of its work on the Holy Land, consisting of a map, in twenty-six sheets, of Palestine west of the Jordan, to be shortly followed by volumes of memoirs containing all the information that has up to the present time been ascertained respecting the geography, history and archæology of the country.

The importance of this map to the study of the bible can scarcely be exaggerated. All previous maps have been constructed from the imperfect observations of the individual travelers, and distances and names were given for the most part conjecturally and at random. Now we have a survey of the country executed by English Engineer officers, and setting forth the topography and nomenclature with as impartial accuracy as an Ordnance map of an English county. It is now for the first time possible to read the narrative of Joshua's marches, of Judas Maccabæus, etc., and to follow the Biblical histories generally, in an intelligent way, mountains, valleys, roads, villages and towns being for the first time accurately laid down.

About 10,000 names incorporated in this map were found by Lieutenants Conder and Kitchener, the officers to whom the survey was intrusted, and the memoirs include a number of others discovered by the French and German explorers Guérin, Renan, Sepp, and others. Among all these exist in some form or other all the Biblical names, only 622 in all, of Western Palestine. These older Hebrew, Canaanitish, and Phœnician names, although they never disappear and leave no trace behind, are often very difficult of recovery, and their satisfactory identification is impossible without the aid of a work like the present, where exact topography and authentic information as to the present nomenclature are available to supplement and verify the deductions of archæological and philological research. In some cases, and these are comparatively few, the old name has survived almost unaltered, such words as Beit-Lahm and Bethlehem, Akka (Acre) and Akko, Bir Seba and Beersheba being such obvious survivals that, taken in conjunction with the collateral evidence from topography, no doubt whatever can be left as to their identity. Sometimes the older name has locally survived a later, though still remote, attempt to change it, as in the case of the ancient Bethogabra, which, though known for centuries as Eleutheropolis, is still called by the inhabitants Beit-Jibrîn, a form that is, if anything, older than Bethogabra itself. In other cases the identification is equally certain, though not by any means apparent to the uninitiated; for instance, Laish has in the Bible the superimposed name of Dan, meaning "Judge," and the spot where

we should naturally look for the remains of the town, is called at the present day, Tell el Kadi, "the Judge's mound." So Paneas became Cæsarea Philippi, but is yet known as Baneas. Sometimes an old name having an approximate signification in the ancient Semitic tongues is misunderstood by the modern Arabic-speaking population, the Hebrew *nahl*, "a stream or water-course," being always confounded either with *nakhl*, "a palm-tree," or *nahla*, "a bee." It will be readily understood that a study of the name lists will yield most interesting results to Biblical students. In spite of the previous identifications, some 200 out of 400 known places have been proposed by the Survey officers. The rest will, no doubt, be recovered without much difficulty when the forms and meanings of the names here given have been thoroughly examined.

The geography of Palestine can now be re-written, for the map of the Survey enables us to lay down the tribal boundaries, etc., accurately; and as the physical features of the country are here exactly set forth, what was before mere conjecture and hypothesis can now be stated as ascertained fact. It is not the religious interest alone that makes the comparatively small territory of Palestine so worthy of deep and careful study. In ancient times the traffic between East and West went of necessity through the country, which became the highway of the world, the focus of trade, and the ground on which rival nations contended for pre-eminence. Here Egyptian, Assyrian, Persian, Greek, Roman, and Moslem civilizations and religions by turn held sway, and traces of their influence and ruins of their magnificence are found at every step. Here is the origin not only of Christianity and Judaism, but of most of those ancient myths around which Grecian art, learning, and philosophy clustered. On the sea coast by Joppa arose the cult and myth of the fish-god Dagon, which appears elsewhere in the legends of Perseus and Andromeda, of Set and Typhon, of St. George and the Dragon, and even of the Archangel Michael and the Devil. From the Tyrian shore, a little further to the north, set out Cadmus, who colonized Greece, and whose very name is perpetuated to day in that of the river Casimiyel and the little Moslem shrine of Neby Casim, the Prophet Cadmiel or Casmiel. Close by is the shrine of Neby Mashuk, the Prophet "Beloved," which is nothing more nor less than the Egyptian temple set up to the terrible Melkarth or Moloch, under the euphemistic title of Miamûn, or the beloved of Amon. On to the shore above Beirut flows the Nahr Ibrahîm, the river of another "Friend of God," here identical with the well-beloved Tammûz or Adonis. And not only the ruins and the names, but the people themselves are curious and interesting objects of study, and Canaanites, Hittites, Amorites, Hebrews, Tyrians are still to be easily identified among the Fellahîn and Bedawîn of the country; in fact, to the theologist, archæologist, ethnologist, and historian every foot of Palestine has matter for research and contemplation, and all this has for the first time been made available as a whole by the labors of the Palestine Exploration Fund. Of these most interesting departments of the subject we shall speak more fully when the promised volumes of the memoirs appear; to the present publication, the map of the Survey,

we can give unqualified praise. It is the joint work of Lieutenants Conder and Kitchener, and was completed in circumstances of exceptional difficulty, the disturbed state of the country in 1877 making it necessary to work day and night (Sundays included), often in the face of considerable personal danger.

The survey was commenced in January, 1872, and finished in 1877; it has cost during that period about £20,000, of which a large sum was expended from time to time in printing reports, etc. The necessary money was raised principally through the energetic action of the Secretary, Mr. Walter Besant, but it must have been relinquished had not Mr. Morrison, the treasurer, himself advanced funds from time to time to carry on the operations at certain critical periods of the Fund's finances.

The earliest Palestine Exploration Society in this country was founded in 1804, but attracted little support. In 1808 the committee published a volume entitled, "A Brief Account of the Countries Adjoining the Lake of Tiberias, the Jordan, and the Dead Sea" (Hatchard, Piccadilly), which was, however, only a translation of some rough notes made by the well-known traveler, Seetzen. Two travelers were then sent out by the society for the purpose of exploring the country, but owing to the accounts they received of the dangerous state of the country they did not proceed further than Malta.

The society after this lapsed into inactivity and its very existence was forgotten until 1834, when all the books, papers, and funds were handed over to the Geographical Society. In 1840 a fresh association was founded with no better results than the former; but in 1864 a survey of Jerusalem was made under the direction of the Ordnance Survey Department by Captain (now Lieutenant-Colonel) Wilson, Baroness Burdett-Coutts supplying the required funds. This called general attention to the defective state of information respecting the country, and in May, the next year, the present society was formally constituted, principally through the efforts of Mr. George Grove, under the name it now bears, "The Palestine Exploration Fund." Captain Wilson, who had completed his survey, was again sent out, in company with Lieutenant Anderson, and the exploration of the country was commenced in earnest. In 1867 Captain Warren commenced the excavations in Jerusalem itself, the progress of which was watched with great interest by the public, and resulted in adding largely to our knowledge of the subject and deciding several weighty problems concerning the sites of the Holy Sepulchre and the Temple. In 1869–70 Mr. (now Professor) E. H. Palmer, accompanied by Mr. C. F. Tyrwhitt Drake, made a journey of exploration through the Desert of the Exodus for and at the expense of the Fund. On his return the survey of Western Palestine was commenced and continued till its completion last year. Mr. Tyrwhitt Drake, who had an extensive acquaintance with the Arabic language and manners, accompanied the officers in the field and afforded most valuable aid in obtaining the correct nomenclature and other information from the natives; his death at Jerusalem in 1874 was a great loss to the society and to geographical science. M. Clermont Ganneau, a well-known

French archæologist, was also employed for a long time by the society and his labors in the country are of the greatest practical importance. The archæological and philological information obtained by these gentlemen is embodied in the work of the Society and immensely increases its value.

It must not be imagined that with the publication of the map and memoirs the work of the Society is at an end. Much that is very important remains to be done, especially the survey of the country east of the Jordan (of which an American association has already completed a reconnaissance map), and the exploration of the cities and remains of the Hittite Empire. The work produced by the Palestine exploration fund during the fourteen years of its existence is of such a character as to merit the continued support of all those who are interested in explorations that yield so much that is important to religion, history, and science.

THE ASCENT OF CHIMBORAZO.

The *Panama Star and Herald* of the 12th ult. publishes the subjoined translation of a declaration made by one of two Ecuadorians who accompanied Mr. Whymper on his second trip up the mountain, which (says that journal), in addition to the word of an English gentleman and the evidence of his companions, ought to be satisfactory to all doubters. The declaration, which was written in French, is interesting as containing a simple and easy account of a difficult journey, as well as substantiating the verity of the first ascent: "I, Javier Campaña, of Quito, hereby declare that upon July 3, 1880, I accompanied Mr. Whymper to the very highest point of the summit of Chimborazo. We were also accompanied by Jean-Antoine Carrel and by Louis Carrel (Mr. Whymper's two Italian mountaineers), and by David Beltram, of Machachi. Mr. Whymper placed his tent on July 2, 1880, on the northwest side of Chimborazo, at a height, so he tells me, of about 16,000 feet, and he provided for the use of myself and of David the things which were necessary for an ascent—namely, good, strong boots with large nails, warm gloves, spectacles to protect the eyes against the glare of the snow, and ice axes to help us along. We started from the tent at 5:15 on the morning of July 3, 1880, and at once commenced to ascend toward the summit. The way at first was over loose stones, but after we had ascended for about 1,000 feet we came to snow, and the remainder of the ascent was entirely over snow, with the exception of one or two little places, where rocks came through the snow. We stopped to eat on one of these little patches of rock at 8:35 a. m., and after Mr. Whymper had examined his mercurial barometer he encouraged us to proceed by telling us that we had already got more than half way up from the tent. From this place we saw the sea. We went on again at 9:05 a. m., and found the snow get steeper and steeper. We were all tied together with good strong rope in case any one should slip, and except for this and for things with which I had been provided we would not have been able to get along

at all. Sometimes it was very cold and there was much wind, but when we were in the sun it was very hot. Whether in the sun or in the shade the snow was very soft, and we sank in deeply, often up to the knees. This was very fatiguing, and it was owing to this that we took so much longer time in ascending the upper than the lower part of the mountain. To break the ascent we zigzagged about, and at one time came round to the side fronting Guaranda, and then came back to above the place where the tent was pitched. At last we got on to the top and could see the two summits. The snow was very soft indeed here, and we went along very slowly, and had often to stop to get breath. The higher of the two summits was on our left hand—that is, upon the north side of the mountain—and we went to it, without going upon the lower one. As we approached the very highest point we saw that there was something strange upon it, and when we got up we found the pole of the flag which Mr. Whymper had put up on January 4, 1880. It stood up about 1½ varas above the snow, and very little of the flag remained, as it had been torn to pieces by the wind. I took a small piece of the flag to show to my friends below, and was filled with joy at being the first Ecuadorian to reach the summit of the great Chimborazo. We arrived at the very highest point of the summit at 1 : 20 p. m., and about the same time ashes from Cotopaxi began to fall. They filled our eyes, noses, mouths, and ears, and made the snow quite black. Mr. Whymper, however, prepared his instruments, and was at work during the whole time we were on the summit. He did not once sit down from the time we left the tent in the morning until the time that we returned to it in the evening. He took the height of the mountain with his barometers, and told us that the observations that he now made agreed very well with those which he made upon the first ascent of Chimborazo, on January 4, 1880. At 2 : 30 p. m. we left the summit, and came down as fast as we could, only stopping a little from time to time to allow Mr. Whymper to collect rocks at various places. We arrived again at the tent at 5 : 10 p. m., and found it covered with the ashes from Cotopaxi, which were still falling, and filled the whole valley with a thick cloud. On the 4th of July we continued the tour of the mountain, and arrived at night close to Tortorillas; and on the 6th we returned to Riobamba, having had a most successful journey, without accidents of any sort whatever, not only having made the tour and the second ascent of Chimborazo, but having also made *en route*, on the 29th of June, the first ascent of Carihuairazo. FRANCISCO J. CAMPAÑA.—Guayaquil, July 19, 1880.—Declared and subscribed at Guayaquil, this twentieth day of July, 1880, before me, GEORGE CHAMBERS, Her Britannic Majesty's Consul, Guayaquil."

SCHWATKA'S ARCTIC SEARCH.

AMERICAN AND ENGLISH METHODS OF ARCTIC EXPLORATION.

The *Herald* editorially sums up the results of Lieutenant Schwatka's sledge journey over 3,000 miles of snow, as follows:

"In a field that seemed to have been already overworked, in which so many hardy adventurers before him had done their utmost to wrest the secret of Franklin's fate from the icy grasp of the polar world, Schwatka went as a late gleaner, and gathered an amount of information that greatly increases the general capacity to understand the story of Franklin's fate. Admiral McClintock, whose own name is famous in the story of Arctic exploration, puts his finger on an important point made clear by Schwatka's experience. Admiral McClintock says: 'What I regard at this moment as the most striking feature of the report you have read for me is the success of Lieut. Schwatka's plan of living on the produce of the land through which he traveled. It is that that distinguishes his expedition from others. All other explorers making sledge journeys have relied chiefly on the supplies carried with them. The Schwatka party, according to this report, was nearly a year absent from its base of supplies, and took only one month's food with it. In adapting themselves to the life of the natives, as they did, Lieut, Schwatka and his followers accomplished something remarkable. This point is fully worthy all the importance that the Admiral gives it. Here is a party of men who go from an American city with infinitely less of the apparatus of Arctic adventure than is usual, making sledging the great element of their operation, live with the Esquimaux as much as they can, accustom themselves to the habits of life and the diet of this mild savage, and they live and are at their ease, and come and go, and are in every way successful in that very district in which the last of Franklin's men perished in the Arctic summer. This contrast presents in the most notable way the difference between two widely varying methods of exploration—methods that may be called respectively the English method and the American method. The Englishman starts with a resolute will to be all and do all; he has a robust self-sufficiency that is the basis of great successes and the limits of whose usefulness he does not recognize. One may read a great many English volumes of Arctic discovery and rise from the perusal with the imagination that all that polar world is a void, an absolutely unpeopled region. On the other hand, the American is adaptable, and is ready to use for his purpose whatever elements present themselves. He makes use of an encampment of Esquimaux to help him over a difficulty just as he would make use of a turn of the tide to move his boat out of a bad place. He divides Nature and uses one part of her forces to overcome the other, and the Esquimaux are forces that Nature has put within his reach. And from an American narrative of how men get on in the Arctic world we rise with the imagination, not that it is an uninhabitable region, but that it is only another part of the Indian country, and that the Esquimaux are unusually placid and tractable

Indians. In this contrast lies an important secret that should be kept in view in all future Arctic operations.

"After reaching from Hudson's Bay, his destination on King William's Land where Franklin's party were known to have perished, the shore was minutely examined by Lt. Schwatka, where the Erebus and Terror remained from September 1846, until abandoned in April, 1848, and how much longer it is not possible to say precisely, though the correspondent recounts some now newly-discovered facts that bear on that point. On one of the ships there beset Sir John Franklin died in June, 1847, and in the weary eighteen months of icy desolation through which the ships were there held immovable the patience and hope of all on board gave way, until they were tempted to abandon the yet sound and well-provided ships and try a desperate homeward adventure by boat and sledge. They had actually made the discovery of the Northwest Passage; their ships were in a channel which when open was continuous from Behring's strait; but they had lost hope and heart and wandered away from their wooden walls to perish miserably on the shore.

"From an old Esquimau, of 65 or 70 years of age, the explorer obtained a clear account of the fate of at least one of the ships. This native reports his encounter with a party of white men, who were apparently of the Franklin expedition, and his subsequent visit to a ship frozen in the ice five miles west of Grant Point. She was watched for awhile, it appears, and no one was seen near her, and as the Esquimaux saw no signs of life they ventured near. They found one dead man in a bunk—the second time the speaker had seen a white man. They used to go on board to steal small articles. Not knowing how to get down below they cut a hole in the side of the ship on a level with the ice, and through this the water got in the next summer and sent her to the bottom. That must have been the summer of 1848. In that year, therefore, within a few months after Franklin's men had abandoned the ships, the ice around them broke up.

"The correspondent writing up the history of the journey states that during the year 2,819 geographical miles, or 3,251 statute miles were traveled, for the most part over unexplored territory, constituting the longest sledge journey ever made, both as to time and distance. Indeed the journey stands conspicuous as the only one ever made through the entire course of an Arctic winter. The party successfully withstood the lowest temperature ever experienced by white men in the field, recording one observation of 71 degrees Fh.; 16 days whose average was 100 degrees below the freezing point, and 17 days which registered 60 degrees Fh., during most of which the party traveled. In fact there was a halt of only one day on account of the cold.

"It is claimed for this expedition that it was the first to make a summer search over the route of the lost crews of the Erebus and Terror, and while doing so buried the remains of every member of that fated party found above ground. The search, it is considered, has established the fact that the Franklin records have been irrecoverably lost at the boat place in Starvation cove. The search for relics of Sir John Franklin's party had one negative result of great importance, as

it extinguishes the hope of any further discovery of written records. They were told that the Natchilli Esquimaux had found a tin box, one foot square and two feet long, containing books, at a point near Back's river, the place where the last of the Franklin party probably perished. The box was found and opened by the natives not long after the death of the white men, that is to say, thirty years ago. The most careful search failed to bring to light any of its contents, which were most likely the written records of the Franklin expedition, and there is hardly a doubt that they were long since irreparably lost or destroyed. They ascertained that the cairn mentioned in Capt. Barry's story has no existence. It is evident, then, that the history of the expedition up to the time of Sir John's death, the particulars of his illness, the story of the wanderings of the crews after they deserted the Erebus and Terror, and many other things that we would most like to know, must forever remain enveloped in mystery.

CHEYNE'S PROPOSED EXHIBITION.

Commander Cheyne is vigorously at work raising subscriptions for his proposed new expedition to the Pole, the cost of which he estimates will be about £30,000. According to the London *Times* it is not improbable that the co-operation of Canada will be invited. By adopting a course of lectures, illustrating Arctic work by means of the lime light, Commander Cheyne has succeeded in establishing an influential central committee in London, and upward of sixty branch committees in England, Scotland, and Ireland, for carrying on a collection of subscriptions, the work being on a voluntary basis. The sum of £1,890 has been secured in London already, in cash and written promises; Captain Bailey, R. N., has brought into the fund £264, besides making a present of a six-man sledge; Messrs. Forrest, the boat-builders, have promised another sledge and £150 worth of limejuice, and limejuice biscuits have also been promised by Messrs. L. Rose & Co. Various other articles are forthcoming in the shape of medical comforts, etc., and Dr. B. W. Richardson, F. R. S., has undertaken to superintend the proper provisioning of the vessel. Mr. John M. Cook has generously given the committee a commodious office, rent free, and has under his consideration a plan for sending a steamer as far as Disco, or Upernavik, taking a party of excursionists and conveying surplus stores across the Atlantic for the expedition, thus saving the expense of hiring a vessel for transport service. Taking all these favorable circumstances into consideration, it has been determined to give notice of a motion to be brought before Parliament early next session, asking for a small Parliamentary grant in aid of this volunteer movement. Support of such a motion is already assured on both sides of the House, there being happily no political bias in the question of our Arctic prestige.

A deputation of the London Central Arctic Committee waited, on the 27th of August, upon Sir John Macdonald, the Premier of the Canadian Dominion, who promised the members that the case of joint action should be submitted for fav-

orable consideration upon his arrival in Canada, as the Canadians took a great interest in the enterprise. Moreover, Commander Cheyne is prepared, in the event of necessity, to reduce his estimate to £20,000, which could be accomplished by taking a smaller vessel, with a reduced complement of thirty officers and crew. With this end in view the Arctic Committee will endeavor to charter from Dr. Oscar Dickson the Vega, lately returned from a successful accomplishment of the northeast passage, under Professor Nordenskjold. This vessel has just been put into thorough repair, and may now have an opportunity of doubling her fame by the circumnavigation of Greenland, in addition to carrying the Union Jack for a contemplated installation at the Pole.

THE CRUISE OF THE STEAMER CORWIN IN ARCTIC WATERS.

The following is the text of a letter received at the Treasury Department from Captain Hooper, of the Corwin:

"*U. S. Revenue Marine, U. S. Steamer Corwin*, St. Michael's, Norton Sound, Alaska Territory, July 10, 1880.—Hon. John Sherman, Secretary of the Treasury, Washington, D. C.—Sir: I have the honor to report our arrival at this port on the 7th inst., after a short cruise in the Arctic ocean. We sailed from here on the 23d of June, and on account of large quantities of ice in the sound to the northward, worked out through the southward and crossed over Behring sea, along the north side of St. Lawrence Island, touching at several places on the Island to inquire into the condition of the natives, and at Plover Bay, Asia, where we took on board about twenty-five tons of coal belonging to the Russian Government. From there we proceeded north, touching at several places on our way, and entered the Arctic ocean on the 28th of June. We have communicated with the natives on the east and west side of Behring's Straits, and as far north as Point Hope, on the American side, and Cape Serdze Kaman, on the Asiatic side. We have also communicated with most of the Whalers now in the Arctic, but can get no tidings of the missing ships. The whalers, without an exception, give as their opinion that nothing will ever be heard of them. We have followed the ice-pack around from Cape Serdze Kaman across the Arctic to Point Hope, and down to Cape Prince of Wales, getting as far north as sixty-nine degrees. The past winter, although very severe south of the straits, appears to have been comparatively mild within the Arctic circle. The whalers all pronounce the ice as unusually light. After following the ice-pack around and finding it impossible to get further north or approach the land near enough to find a harbor, we returned to this place on the 7th for the purpose of filling up with coal, cleaning boiler, etc. This work has been completed and we sail at meridian for the Arctic *via* places on the north side of the sound, which we could not visit before on account of the ice. Kotzebue Sound was full of ice when we came out, but I hope to find it clear on our return. As soon as we can get in there I shall detail an officer, with an armed boat crew, to keep a sharp look out

for whisky traders, and go north again as far as Herald Island to continue the search for the whalers. I hope to reach Wrangel Land by the middle of August or first of September. We were within 140 miles of it on our recent cruise. The Corwin works entirely satisfactorily in every way, and all hands are in good health and spirits, and everything on board harmonious. I shall mail this by the schooner, Western Home, belonging to the Western Fur and Trading Company, which leaves for San Francisco in a few days, touching at several places on the mainland and Aleutian Islands on the way down. I am, very respectfully, your obedient servant, C. L. HOOPER, Captain U. S. R. M.

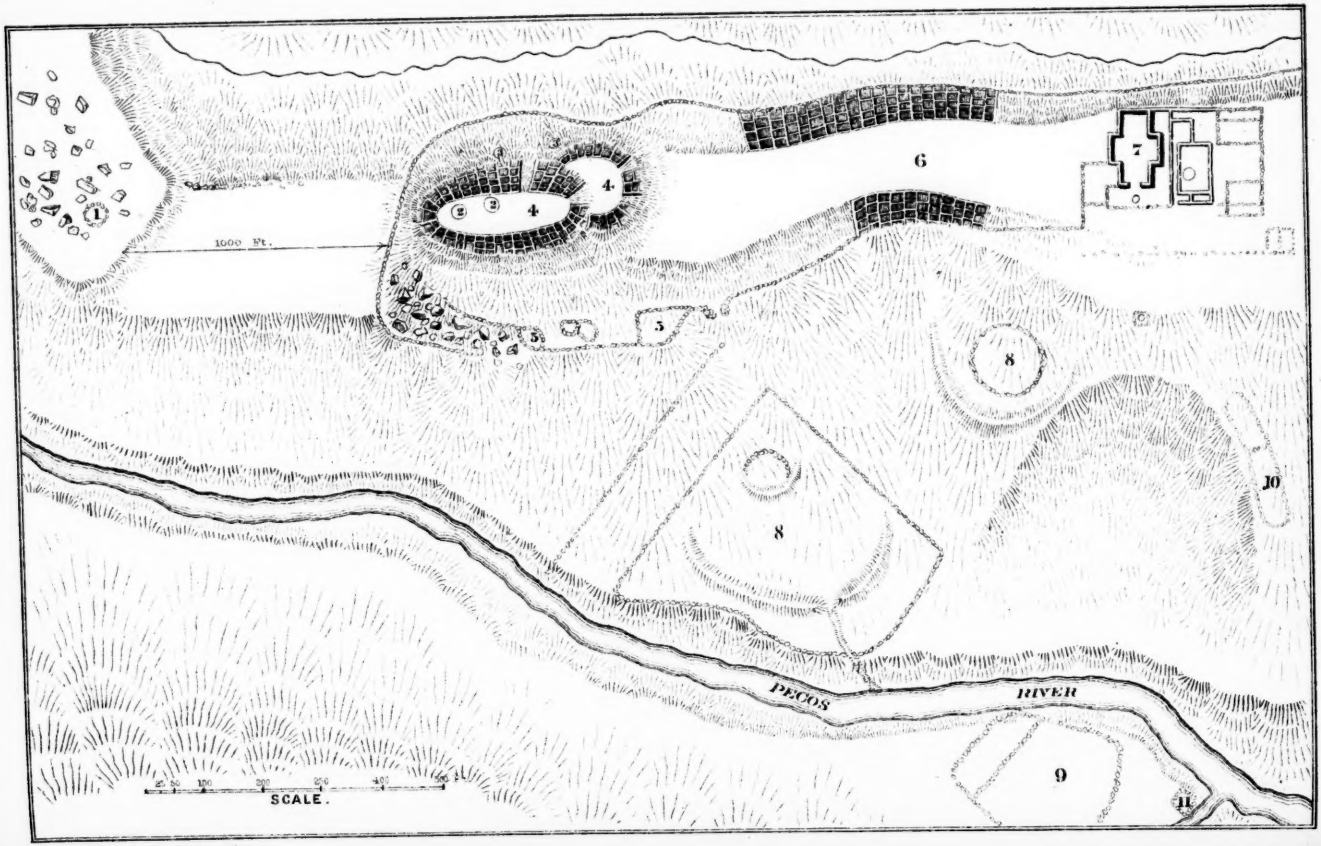
THE HOWGATE EXPEDITION.

The Arctic steamer, Gulnare, arrived at St. Johns, N. F., September 25, having turned back at Disco, Greenland. One of her officers reports as follows: "After leaving St. Johns the weather was fair until August 2, when we were caught in a southwest storm which drove us within a few miles of Cape Farewell. A large hole was smashed in the stern and the larboard boat swept away, the bulwarks stove in and the deck load of lumber, intended for the house to accommodate the party to be left in the Arctic, was washed overboard. We arrived in Disco on September 8, and remained until the 21st, repairing damages. We went to the coal mines above Rittenbank, but found much difficulty in coaling on account of their being no anchorage and much ice in the Waigatt. We left for St. Johns with an insufficient supply of coal and sailed most of the way. All are well on board."

Dr. Pavy and Mr. Clay remained at Rittenbank, where they will winter and prepare for the work of next year. The whole ship's company are in good health and condition, and suffering from nothing more serious than the natural disappointment that follows after baffled hopes.

LIEUTENANT DOANE'S REPORT.

ST. JOHNS, N. F., September 25, 1880.—Captain H. W. HOWGATE: The Gulnare returned last evening. Lost one boat and all the deckload in a gale on the 31st of August. Reached Disco on the 8th with two planks loose, and stove in starboard quarter. Till 21st repairing. Took two weeks to coal half supply. Came in here mostly by sail. Pavy and Clay remained at Rittenbank. No casualties. DOANE.



Ramsey, Millett & Hudson, Lith. Kans. City

ARCHAEOLOGY.

A HOLIDAY EXCURSION BY RAIL TO THE BIRTH-PLACE OF MONTEZUMA.

THEO. S. CASE, KANSAS CITY, MO.

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Arrived at Baughl's station, on the Atchison, Topeka and Santa Fe rail road, which is no more than a siding where rail road ties are received and handled, and which simply consists of a boarding car and two saloons, we started on foot for the scene of our explorations, about one mile and a half distant. Before entering upon a description of the ruins found here, I will say that notwithstanding the volumes that have been written by the explorers of this central portion of the Western Hemisphere, descriptive of its past civilization, the vastness and perfection of that civilization have been by no means comprehended. Every day the hardy and venturesome prospectors of New Mexico, who, like the Spaniards of the sixteenth century, are urged on by an ardent quest of precious metals, discover new evidences of the existence in prehistoric times of a race of men who, in architecture, agriculture and metallurgy, possessed a degree of knowledge and skill hardly surpassed in any age.

The discoveries of these explorers also go far to prove that the land which is now so utterly unproductive, was once sufficiently arable and prolific of vegetation to support a dense population, and that the various reasons which are proposed by the writers of the present day to account for the abandonment of the country by these people, such as superstitious fears, the aggressions of hostile tribes, etc., are futile and unsatisfactory.

It seems unquestionable that some vast change took place in the geological and physical condition of the country, causing its fountains to dry up, and changing its fertile valleys into arid wastes, thus literally starving the people out and forcing them to seek new homes. This idea brings to the front the theory and tradition of the Continent of Atlantis with more plausibility than almost any other: a theory which, if established, will enable us to account for the migration of ancient peoples from one continent to the other without tasking our credulity with the extremely doubtful one of the Behrings Straits route.

Before we had proceeded more than half a mile we came into view of the church and ruins of Pecos, lying on a beautiful plateau on the further side of the Pecos river, and separated by a narrow valley from a commanding range of mountains several miles beyond. This plateau seemed to be completely sur-

rounded by mountains; those on the west being grand in their outline and crowned by a bald peak, which appeared exactly adapted for a watch-tower for the people of the city on the plateau, and perhaps for an outlook for the priests of the sun, who from its lofty summit, could catch his earliest rays long before they would be visible to the people below. The whole valley, from mountain range to mountain range, is about five or six miles, while it seems to be inclosed at both ends by purple ranges, about ten miles apart, with an occasional snow-capped peak. Thus apparently hemmed in on all sides, and in the midst of what was probably in the day of their prosperity a luxuriant and fertile plain, these ancient people built their singular houses and lived peaceful and quiet lives. The evidences of their civilization are found in abundance, in implements for grinding corn, pottery evincing various degrees of skill, and in some places in pictured rocks and decorated caves.

These houses are very much alike in all the villages that are known, being built against the sides of bluffs or rocky acclivities, one story above another to the height sometimes of five to six or seven stories. The material used is stone, cemented together and sometimes coated or plastered on the outside, with mud. The first story has no opening except at the top, which is reached with a ladder, while the other stories have doors opening from the roofs of those below. Within, or at least in the lower or basement stories, there are connecting openings from one to another. The stories are separated by floors of timbers laid together and sometimes bound together with withes. Remains of corner-posts made of pine and cedar poles are found abundantly in their proper position.

The system of walls and outworks is very extensive, but whether it is all of the same age as the village, is more than I was able to determine. Commencing at the western end of the plateau, the first evidence of the hand of man that I discovered, was a circular stone wall inclosing a space thirty feet in diameter. (1 in plate.) This is located upon a rocky point some fifty feet above the adjacent ground, and commands a view of the valleys on both sides, as well as of the plateau beyond, upon which the village is built. From all indications this was a fort or lookout tower. (W. H. Holmes in Bulletin No. 1 of the United States Geological and Geographical Survey of the Territories, vol. II, 1876, describes the ruins of a tower found in the Mancos cañon in Colorado, probably similar to this, whose outer dimensions were forty-five feet in diameter and twelve feet in height at the highest point of the wall yet standing, which is twenty one inches in thickness. It was doubled walled, with apartments between the outer and inner walls.

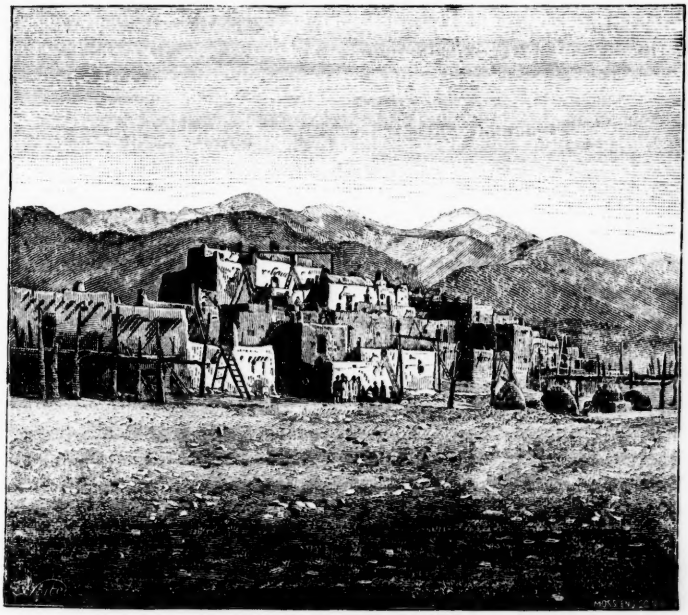
On the *mesa* above the bed of the River McElmo, a square shaped tower was discovered standing in on the summit of a great block of sandstone, forty feet high and detatched from the bluff back of it.

At another place on the McElmo, the ruins of a triple-walled tower were found, with sectional apartments between the outer and second walls, and such towers abound on prominent points all along the Gila, Chaco, Rio Grande and other rivers of Colorado and New Mexico.) Proceeding eastwardly, we descend from this point some twenty feet or more to a long and narrow passage of bare rock,

not less than 1000 feet long, by an average width of about one hundred feet. On the north side, this passage is defended by a stone wall running along the edge of the rock for a distance of about 300 feet. For the remainder of the distance to the foot of the bluff upon which the ruined village is built, there is no sign of any work done by man.

At the foot of the bluff just mentioned, we come upon the remains of a stone wall which runs around both sides of the plateau from village to church, being in its whole length not less than 2000 feet. This wall seems to have been intended for defense, as it is located on the extreme edge of the plateau, all around, just where the steep and almost perpendicular declivity begins.

Commencing here, we are amazed at the size of these ruins. (4.) The buildings were commenced at the foot of the bluff, the rooms of the first story being, say, 8x10 feet and about 7 feet in height. The rooms on this floor have no doors in the side-walls, but are entered from the roof, which is reached by a ladder. Upon this story another is built which sets back from the front of the first, and like it leans against the side of the bluff. This story has doors in the front of the rooms, which are entered from the roof of the lower story. In this way as many as six or seven stories are built one upon another, and the buildings are extended laterally as far as the necessities of the community demand, all united as closely together as cells in a honey-comb.



PUEBLO VILLAGE AT TAOS, NEW MEXICO; NOW INHABITED.

In this Pecos village there were not less than 1000 rooms, and probably many more. I could readily count two hundred rooms at the top, and from four to six stories on the sides of the bluff. The whole group seemed to consist of two irregular circles, the larger of which extended partially around the end of a rocky bluff about thirty feet high above the bare rock just described, rising two stories above its summit and completing the circle or oval upon the surface of the bluff. This circle is two hundred and twenty-five feet across in one direction, say east and west, and seventy in the other, with one opening or passage, say sixteen feet wide, leading down the face of the bluff on the northern side, and one into the inclosure on the east.

This area contains two basin shaped, stone-lined reservoirs, probably for water, twenty-five feet in diameter and more than six feet deep, (2) as was proven by digging into them to that depth without finding the bottom of the stone-lining. They are filled with earth to within some three or four feet of the surface. Outside of the circle of huts, at the foot of the bluff on the north side, but inside of the stone wall above named, are two similar stone-lined, basin shaped reservoirs, sixteen feet in diameter and filled within two or three feet of the surface. (3.) One of these is on each side of the passage-way before mentioned. A very singular thing is, that the western of these reservoirs seems to be connected with one of those inside, by an aqueduct or conductor, constructed wholly of cement made of ashes and some other substance, possibly lime, though no lime or cement of any kind is found in any other part of the works.

This aqueduct is exposed at the margin of the reservoir nearest the bluff and is at least two feet in diameter, with walls not less than eighteen or twenty inches in thickness. It was constructed by making lumps and blocks of the cement, some rounded and some flat, varying from four to ten inches in diameter and laying them upon each other like bricks and fastening them together with layers of similar cement, and finally smoothing the whole over with a coating of the same. I had no implement but an old hatchet, and could do but little in the way of excavating this aqueduct, and may have been mistaken as to its object and purpose, but from its locality and shape, as disclosed by my cutting into it some two feet or more, I think I am correct.

Adjoining the inclosure above described on the east, is a small one, also built around with similar stone huts, two stories high, which is about sixty by seventy feet in diameter and has two gateways, one to the north-east and the other to the south-east., each ten feet wide and thirty-six feet long. To the southward of both of these inclosures and close to the rocky declivity, which is bold and commanding, are several remains of walls and buildings, nothing being left but the foundations and some loose rock. The first or western of these is 24x58 feet, the second 24x27, and the third 10x30. Still further east and on the extreme point of the rock is a triangular shaped inclosure 54x69, the third side being made by the wall on the edge of the bluff. From the situation of these (5), especially the last named, they were evidently for the purposes of defense and outlook.

XUM

Just east of the huts last described, the ground slopes rapidly to the east and south, with ledges of bare rock making a kind of wall to the southward and westward. Still proceeding eastwardly we pass over some two hundred feet of bare, smooth rock when we come to two other groups of ruins (6), about four hundred feet in length, one on each side and overhanging the respective bluffs on the north and south sides of the plateau. There are about eighty huts in each of these groups on the summit, making probably about two hundred in all, when averaged at two stories high. They are similar to those just described, being made of stone cemented together with mud, and arranged in rooms of from six to ten feet square, those in the basement story being connected by openings underground. Between these groups of huts the space is nearly or quite two hundred feet wide.

We did not find any rooms among them answering to the description given by several explorers of the *Estufas*, where the sacred fire was kept burning, unless the circular, stone-lined basins, within the court of the larger village, may have been originally covered over and used for such a purpose.

Dr. Hammond, who accompanied Lieutenant Simpson in his United States military reconnoissance in New Mexico, in describing the ruins of Chaco, speaks of sacred *Estufas*, circular in form, excavated several feet deep in the earth and inclosed with circular walls. The fact that no water, except perhaps the drippings from the roofs of the upper tier of huts, could naturally find its way into these basins, gives probability to the suggestion that they may have been constructed for *Estufas*, instead of for storing water.

On the south side of the plateau, about half-way between the first and second village, is a gateway in the outer wall, which in that part is six or seven feet high and from three to four feet thick. This gateway is about ten feet wide, and was apparently made to enable the inhabitants to pass out their stock to graze and to water in the inclosures which will be described a little later.

Having now described nearly everything on the plateau that seems to belong to the Aztec civilization, we will pass out of the gate just mentioned, on to the slope that descends gradually to the Pecos river, which winds its way along at a distance of a few hundred yards to the southwardly.

The first thing which attracts our attention is a long stretch of ruined wall which extends in a south-westwardly direction from a point within about 120 feet from the gate to the bank of the river, 600 feet away. Just beyond the upper end of this wall we find an inclosure (8), walled all the way around, 390 feet by about 120 feet, and banked up with earth at the lower part as if to retain water. Just at the lower corner there appears to have been an artificial outlet through the dam and wall for prudential purposes. Within this inclosure is a circular artificial pond, also banked up with earth, about seventy-five feet in diameter. Just east of this inclosure and a little further up the slope is another (8), apparently constructed for the same purpose, being nearly as large and banked up across the lower part in a similar manner. Within this, also, is a smaller circular pond 120 feet across, which even at this time was muddy in the center, although it did not contain any water.

XUM

Still proceeding eastwardly, there are traces of walls and apparent foundations of buildings all along the slope, and on a little eminence about 200 yards southeastwardly of the inclosure last described are the remains of two walls (10) inclosing spaces respectively 100 feet square and 125 x 140.

On the opposite side of the Pecos river, between it and a small stream which empties into it, and 345 feet southeast of the water inclosure first above described is a kind of pentagonal inclosure 240 feet in diameter (9) and crossed by another wall which divides it into one large and one very narrow compartment. Just beyond and southeast of this are the remains of what has apparently been a fortification, situated just at the confluence of the two streams.

This completes the description of the outside works. We will now return to the plateau. Passing from the groups of Aztec huts last described, we proceed eastwardly 180 feet and find ourselves face to face with the old Pecos church itself. Before describing this old building (7), we will refer to the history of the discovery of the village, which had its origin long before the Spanish invasion, and which is held by the Aztecs to have been the birth-place of Montezuma himself.

There seems to be no doubt that the Aztecs migrated from some more northern region, into Mexico, and the traditions of the present Pueblos, who are believed to be descendants of the original Aztecs, teach that this very spot was the birth-place of Montezuma. But Short, in his "North Americans of Antiquity," claims that this is a different civilization and that the culture-God Montezuma of the Pueblos and the Aztec monarch, Montezuma, are not to be confounded. Dr. Foster, in his "Prehistoric Races of America," does not speak of any such distinction. At all events, all writers agree that Pecos is one of the most important of all the ancient ruins of this region, and that it was one of the sacred cities of the Pueblos. Here the everlasting fire, dedicated to their god Montezuma, was kept burning from time immemorial down to the abandonment of the town, which occurred, according to Short, some time during the second quarter of the present century. Other authorities fix the year at 1837.

One tradition is that Montezuma was born at Acoma, and subsequently removed to Pecos, where he taught the people the arts of civilization, and that when he removed to the South he told them to keep the sacred fire burning until his return. But he never came. Warriors watched the fires and remained on duty by turns, until through decimation from one cause and another, the tribe became too much reduced in numbers to keep up the watch any longer. Then three warriors took the remains of the fire and carried it into the mountains, where Montezuma himself appeared and received it Thus relieved, they abandoned their village and joined their brothers west of the Rio Grande.

"For generations," as Short eloquently says, "these strange architects and faithful priests waited for the return of their God—looked for him to come with the sun, and descend by the column of smoke which rose from the sacred fire. As of old the Israelitish watcher upon Mt. Seir replied to the inquiry: "What of

the night?" "The morning cometh," so the Pueblo sentinel mounts the house-top at Pecos, and gazes wistfully into the East, for the golden appearance, for the rapturous vision of his redeemer, for Montezuma's return, and though no ray of light meets his watching eye, his never failing faith, with cruel deception, replies "The morning cometh." "

In about 1540 Coronado, the Spanish governor of New Spain, lured by the resistless rumor of boundless wealth of gold and silver, which no Spaniard could withstand, led an expedition to this very village, then called Cicuyé. The Pecos river must have been a far larger stream than at present, as Coronado found it frozen over with ice strong enough to bear up his horses. He found the settlement of Cicuyé extending along the river for six miles, and the soil extensively cultivated by the Indians. It was from that time that the decline of the tribe commenced. The date of the building of the church is not exactly known, but it was probably very soon after the invasion by Coronado, for zeal in religious matters was next to lust of gold in the heart of the Castilian in all of his conquests.

We may imagine that the gentle and tractable Pueblos were speedily induced by their enthusiastic conquerors, to embrace Christianity, and that the building of this church was a work of fear of temporal power, rather than of faith in and love of the deity represented by the Spaniards. It was constructed of adobes, which are about sixteen inches long, twelve inches wide and three inches thick. Its shape is that of the Latin cross, its walls six feet thick and its dimensions one hundred and forty feet long by forty feet wide; the transverse portion being fifty-seven by thirty-five feet, and its original height about thirty feet. There were several smaller rooms attached on each side, and possibly a building of considerable dimensions on the west side, as there are traces of adobe walls which indicate either a building or an inclosure divided into several smaller rooms or lots. I have in my possession a book published in 1854, containing an engraving which represents the church as having a building on the west side. I could find nothing in the appearance of the ground to indicate anything of the kind, either in the way of rubbish or otherwise, and it seems to me, if the church itself could so well withstand the ravages of time, any adjoining buildings would have endured as well. The roof of the church has been nearly gone for many years, and the side-walls of the front end are also crumbled away nearly to the ground. The rear portion is nearly at its original height, and some of the cross-beams with their rude carvings, remain *in situ*. The others have been cut away by curiosity hunters

The adobes of which the building is constructed, are made of a reddish clay containing small pieces of pottery of a ruder and coarser order than that found about the Pueblo villages. In one of these inclosures just west of the church is a small excavation about twelve feet in diameter, evidently the remains of a water-reservoir. Immediately in front of the entrance and about forty feet from it, is what seems to be an old well, which had been walled up with stone and has been more recently filled up with earth.

About seventy-five feet still further on, we come to the traces of an old wall term.

inating on the East in the ruins of several small rooms or inclosures, also of stone. About eighty feet still further and directly in front of the entrance to the church, is an inclosure about eighteen feet square, with a central stone heap about three feet square. Still further in the same direction we find a semi-circular declivity, which was probably originally the work of man, which terminates on the right at the water inclosure described on page 423, and on the left at the stone inclosures described on the same page.

In speaking of walls, it is to be remembered that most of them are ruins and many of them mere traces, although readily discernible as one walks over the ground.

Leaving the church for the present, we will turn back to the ruined villages in search of relics. Broken pottery abounds on all hands, and it seemed to me that I could detect specimens representing at least three distinct periods of time: First and oldest, that found in the adobes of which the church is built, which is coarse and rough; second, that which is made of finer clay, but without ornament, and lastly, that which is painted; and perhaps fourthly, that which shows an effort at glazing.

We found numerous flint arrow heads, all of which were small, none being over one and a half inches in length. Perhaps this is due to the fact that the larger ones have been picked up by earlier explorers. We also found several broken *metatas*, or grinding pestles, and in one of the large rocks near the upper village, I found three bowl-shaped cavities, about ten inches in diameter and from three to four inches deep, which I conceived to be the mortars in which the natives ground or beat their corn into meal.

We also found numerous pieces of obsidian which appeared to have been split off in keen flakes for cutting purposes; also fragments of smoking pipes with more or less ornamentation cut or scratched upon them. Besides these things, we discovered smaller ornaments, in the way of shells pierced for suspension, pieces of selenite roughly carved into ornamental shapes and small bits of red paint. Not a scrap of iron or any kind of metallic weapon, tool or implement could be discovered in either church or village—not even a nail—though it is well known that the natives understood the art of smelting ores, at least those of silver and gold, and of working them most artistically. If other proof of this knowledge were wanting, we could supply it in the form of several pieces of slag picked up near the villages; and the people who reside near say that remains of old smelting works are still to be found in the mountains.

Parts of three days were given to this exploration, in company with Mrs. Case, Major H. Inman of Kansas, and Mr. A. H. Whitmore of Las Vegas, all of us being greatly interested and more than willing to devote much longer time and labor to a more complete examination of these ruins, should another opportunity present itself when we were better prepared to do them justice.

A great many more most interesting things were seen by us in New Mexico, but the limits of this paper have been reached, and an account of the remainder

must be postponed until another time, with the closing suggestion, that had these industrious and ingenious natives not been disturbed and driven out by the thriftless and avaricious Spaniards, who have never improved any country by their conquest of it, they would in all probability have built up the ruling empire of North America, and thus at least have kept alive the fire of civilization kindled by Montezuma—the culture God—in their minds, until the day of his return, in the millenium.

ASTRONOMY.

PLANETARY PHENOMENA FOR NOVEMBER, 1880.

BY W. W. ALEXANDER, KANSAS CITY.

Mercury sets on the 1st at 5 h., 54 m., p. m., and rises on the 30th at 5 h., 50 m., a. m., and is in inferior conjunction with the sun on the 23d.

Venus sets on the 1st at 6 h., 23 m., p. m., and on the 30th 6 h., 57 m., p. m.

Mars rises a few minutes before the sun, but is too near that luminary to be seen.

Jupiter sets on 1st at 4 h. 10 m. a. m., and on the 3th at 2 h. 7 m. a. m.

The following is a brief summary of the phenomena presented by its four moons, Io, Europa, Ganymede and Callisto, the time used being Kansas City mean solar time:

On the 1st, from 5 h. 52 m. to 8 h. 6 m. p. m. Io will be making a transit of Jupiter's disk.

On the same day from 6 h. 31 m. to 8 h. 45 m. p. m. Io's shadow will likewise pass in transit.

On the same day from 7 h. 57 m. to 9 h. 37 m. p. m Europa's shadow will be making a transit. Europa will egress from a transit at 8 h. 20 m. p. m.

On the 2d at 5 h. 59 m. 17 s. p. m. Io will reappear to the east of the planet at the end of the eclipse.

On the 3d at 6 h. 51 m. p. m. the shadow of Ganymede will end a transit.

On the 7th at 10 h. 26 m. p. m. Io is occultated and disappears.

On the 8th from 7 h. 38 m. to 9 h. 52 m. p. m. Io will be making a transit.

On the same day from 8 h. 26 m. to 10 h. 40 m. p. m. the shadow of Io will make a transit.

On the same day from 8 h. 1 m. to 10 h. 40 m. p. m. Europa will be making a transit.

On the same day at 9 h. 36 m. p. m. the shadow of Europa will commence a transit which will last until after midnight.

XUM

On the 9th at 7 h. 54 m. 55 s. p. m. Io reappears at the end of an eclipse.

On the 10th at 6 h. 28 m. p. m. Ganymede will egress from a transit.

On the same day at 6 h. 45 m. 38 s. p. m. Europa will reappear at the end of an eclipse.

On the same day from 7 h. 22 m. to 9 h. 52 m. p. m. the shadow of Ganymede will be making a transit.

On the 15th from 9 h. 26 m. to 11 h. 39 m. p. m. Io will be making a transit.

On the same day at 10 h. 22 m. p. m. the shadow of Io begins a transit which lasts until after midnight.

On the 16th at 6 h. 40 m. p. m. Io disappears by being occultated, and reappears from being eclipsed at 9 h. 50 m. 38 s. p. m.

On the 17th at 6 h. 6 m. p. m. Io ends a transit, and at 7 h. 4 m. its shadow likewise leaves the disk of Jupiter.

On the same day from 7 h. 27 m. to 10 h. p. m. Ganymede will be making a transit, and at 11 h. 25 m. its shadow will begin to make a transit.

On the 23d at 8 h. 29 m. p. m. Io is occultated and disappears, and reappears after being eclipsed at 11 h. 46 m. 26 s p. m.

On the 24th from 5 h. 40 m. to 7 h. 55m. p. m. Io will be making a transit, and from 6 h. 46 m. to 8. h. 59 m. its shadow will likewise pass across the disk of Jupiter.

On the same day at 7 h. 10 m. p. m. Europa will disappear by being occultated, and reappear from an eclipse at 11 h. 57 m. 19 s. p. m.

On the same day Ganymede begins a transit at 10 h. 59 m. which lasts until after midnight.

On the 25th at 6 h. 15 m. 21 s. p. m. Io reappears at the end of an eclipse.

On the 26th at 6 h. 54 m. p. m. the shadow of Europa ends a transit.

On the 28th at 5 h. 27 m. 38 s. p. m. Ganymede disappears by entering the shadow of Jupiter and reappears coming out of the same at 7 h. 40 m. 46 s. p. m. Both the disappearance and reappearance happen at some distance to the east of Jupiter.

On the 30th at 10 h. 20 m. Io is occultated.

Saturn sets on the 1st at 5 h. 14 m. a. m., and on the 30th at 3 h. 10 m. a. m.

Uranus rises on the 1st at 1 h. 48 m. a. m., and on the 30th at 11 h. 55 m. p. m.

Neptune rises on 1st 5 h. 10 m. p. m., and on the 30th sets at 4 h. 51 m. a. m.

Our moon begins its monthly course by passing the Sun on the 2d and Mercury and Venus on the 5th. On the morning of the 13th it will pass north of Jupiter 7° 7′ of arc.

On the evening of the 15th at 5 h. 30 m. it passes north of Neptune 5° 41′ of arc.

It also occultates eleven stars during the month visible at Kansas City.

APPLIED SCIENCE.

THE TELEGRAPH AS APPLIED TO THE FISHERIES IN NORWAY.

TRANSLATED FROM LA LUMIERE ELECTRIQUE, BY MISS IDA HOWGATE.

The International Fish Exhibition which has just closed at Berlin has called attention to the results obtained from the application recently made in Norway of the electric telegraph, for the benefit of the coast fisheries.

The *Revue de l' Union des telegraphes anstro allemands* has already spoken, in 1866, page 298, of the commencement of this work; but, to-day we are able to give more fully, some details of its development and of the activity in business resulting from its introduction.

All the telegraphic stations which are connected with the fisheries, and with the sale of their products, are situated at the north of Drontheim. The first telegraph for fishery was established in 1861. At first there was a single local line in Loffoden, but, in 1868 it was attached to the general telegraphic system by a wire 690 kilometers in length, going from Brettesnaes to Namsoes, and uniting with a line (Namsoes-Drontheim) already constructed.

The Loffoden line was extended, in 1869, to Tromsoë, and, in 1870 it reached, in passing through the most northerly cities of the country, Hammerfest, Vadsoe, and Vardoe, as far as the banks of the Glacial sea. From 1870 to 1877 the principal line was completed by the addition of numerous lateral lines, and by a prolongation, passing by Vardoe, along the coast of the Glacial sea as far as Berlevaag. The entire length of the wire-work in the northern fishing districts comprises 3,595 kilometers of line, and 5,190 kilometers of cable, thereby increasing the expenditure to 2,600,000 crowns.

In view of the serious accidents to which telegraphic conductors are liable in Arctic regions, on account of the climacteric influences, especial precautions have been taken to protect them from exposure. The operators at first use, as conductors, a group of three iron wires, three millimeters in diameter, twisted so as to represent one solid wire 5.2 millimeters in diameter. On the most inaccessible mountains, a steel wire 0.7 millimeters in diameter, has been added to this conductor, to be used in case of accidents. The soldered points are made secure by strong joining muffs.

Among the telegraphic lines mentioned, those found along the coasts near Stavanger and Bergen are devoted principally, in winter and spring, to herring fishing, which, in these places, is from the middle of January or the beginning of February to the middle of March, and occupies about 40,000 men each year. During these months the herring, as is well known, come near the coast to deposit their spawn in the shallow waters and under the protection of the rocks.

The first indications of the arrival of the herring are seen shortly before their appearance. Innumerable numbers of fish are noticed coming from the high sea and approaching the shore; according to the popular language, a mountain of herring arrive, and is followed by cetaceans and myriads of birds. Inspectors belonging to the fisheries then send by telegraph, to all the telegraphic stations interested, regular information, which is published, so as to keep the fishermen constantly advised of the arrival of the fish: some extra telegraphic stations are, moreover, held ready to be installed at any point on the coast. From the moment the herring pass the entrance of the Gulf, the telegraph indicates their slightest movements, which are attentively observed on the two coasts. Warned by the telegraph, the fishermen soon hasten from all directions with their nets, boats, casks and salt; the purchasers and the traffickers accompany them, and all take the road to where the fishing is likely to be most fruitful. The people on the coast know very well how to appreciate the important rôle which the telegraph plays in their industry, and in the frequent cases when the capture of fish has only been possible by the intervention of the telegraph, the name of "haering du telegraph" is given to the captured fish.

Up to 1870, the telegraphic stations established for the "Vaar-haering" fish were by far the most important; but those which have been constructed since that period for the cod and fat herring (summer and autumn herring) have taken the first place, and now surpass the former as much in regard to extent as to importance. The cod and fat herring fishing is carried on in all the fishing grounds along the coast, from Aalesund to Christiansund, near the Loffoden islands, and on the coasts of the two sides of North Cape, as far as the Russian frontier. It also employs about 40,000 men. This fishery would evidently not be such a source of wealth to the thinly scattered population, if it were not for the telegraph which continually apprises them of the approach of the shoals of fish. The importance of the telegraph is felt especially in autumn, when the fat herring enter the fiords in large numbers.

Apart from the information given concerning the movements of the shoals of fish, the progress of the fishing, the price of the fish, etc., are also sent by telegraph to the different fisheries, and to the cities interested. Furthermore, then telegraph forwards, each day during the fishing season, meteorological bulletins, information concerning the direction and force of the wind, the state of the sea, the temperature, the probability of storms, etc., which is of inestimable value to the residents on the sea shore.

The telegraph is in use three or four months of the year for cod fishing. There are nine telegraphic stations called *de poisson*, and four movable stations, which are transferred from Loffoden to Finmark, for this fishing alone. Besides these, six or nine telegraphic fish stations, and one or two extra stations in the districts of Bergen and Stavanger, remain in active service two or three months in each year, for the Waar-Haering fishery, in addition to which, more than twenty stations are in use during the whole year for the cod and large and fat herring fisheries.

If the principal telegraphic line connecting Drontheim to the northern cities is not taken into consideration, it is found that a capital of about two millions of crowns has been expended for the telegraphic stations, called *de pichenis*, in the fishing districts. The relative importance of this sum can be estimated by noticing that the capital which has been used for the establishment of all the telegraphic stations in Norway, does not exceed 5,300,000 crowns. The expenses of the telegraph for fisheries represent, then, more than a third of the capital of all the lines. It is unnecessary to say that the receipts of the fishing stations, in consequence of the situation of the fishing places, where often few families reside long, are far from covering the expenses which the working of the lines involves. The cost of establishing and keeping these lines in repair also draws heavily on the revenues of the administration of telegraphs in Norway. However, the assistance which these stations render is so important, the capital invested in the fisheries so considerable, and the benefit afforded to the inhabitants so great, that the government finds it to its advantage to aid, as much as possible, the development of this service along the Norwegian coasts.

THE SYNTHETIC PHILOSOPHY.

THE DOCTRINE OF THE UNKNOWABLE.

READ BEFORE THE KANSAS CITY ACADEMY OF SCIENCE, SEPTEMBER 28th, 1880.

BY W. H. MILLER, KANSAS CITY, MO.

In a previous paper, we examined the "Synthetic Philosophy," of Mr. Herbert Spencer, in its aspects as philosophy, and found fault with it, for its failure to make any attempt to explain the ultimate form of being, which it holds to be unknowable; for its absurdity in explaining the known into the unknowable; for its failure to supply certain inductions, which we found to follow necessarily from its premises, and which would have explained its unknowable as a personal God; and for setting up force as the ultimate form of being, which we found to be but that property of being by which it expresses itself in action. We also included certain deductions, which, like our inductions, show that this ultimate being is a personal God; but, as the philosophy holds that all such deductions are illegitimate, we propose here to put them to the test of examination, and determine if this is the case. These deductions are denied, not only by this philosophy, but by all who adopt it, and by all who accept the modern hypothesis of evolution; for both forbid us to assign any attributes, aspects or qualities whatever to ultimate being, upon the basis of which alone it can be held to be unknowable. Whether these deductions are legitimate or not, may be shown by a brief reference to the necessary conditions of thought. This involves an inquiry concerning these

conditions, and the limits and nature of human conceptions in the direction of the Infinite and Absolute. We cannot take a better point from which to project this inquiry than the deliverances of this philosophy, and its quotations from others upon which it relies for support.

We find it quoting extensively from Sir William Hamilton and Mr. Mansel, certain of their conclusions on the subject, in which they have given their great names and high authority to grave errors, which underly that mysticism of modern times, which has corrupted philosophy in its sources, given to scientific truth a shadow of uncertainty, and to religion an unbelief that is a fruitful source of immorality.

Sir William Hamilton, in his essay on the "Philosophy of the Unconditioned," holds this language. "The mind can conceive, and consequently can know, only the limited and the conditionally limited. The unconditionally unlimited, or the Infinite, the unconditionally limited, or the Absolute, can not be positively construed to the mind; they can be conceived only by thinking away from, or abstraction of, those very conditions under which thought itself is realized. Consequently the notion of the unconditioned is only negative—negative of the conceivable itself." To the doctrine that the mind can conceive of no more than "the limited and the conditionally limited" all must subscribe; but the doctrine that the mind can attain to a conception of any kind whatever, by "thinking away from, or abstraction of those very conditions under which thought itself is realized," represent the mind as transcending its conditions, and is absurd. And that it can entertain a notion that is "negative of the conceivable itself" is equally so, for it represents the mind as conceiving an inconceivable nothing. A he says: "As the conditionally limited (which we may briefly call the conditioned), is thus the only possible object of knowledge and of positive thought—thought necessarily supposes conditions. To think is to condition; and conditional limitation is the fundamental law of the possibility of thought. For as the greyhound cannot outstrip his shadow, nor (by a more appropriate simile) the eagle outsoar the atmosphere in which he floats, and by which alone he is supported; so the mind cannot transcend that sphere of limitations, within and through which exclusively the possibility of thought is realized." To this likewise, all must subscribe, but, this being true, how can the mind, by "thinking away from, or abstraction of, those very conditions under which thought itself is realized," attained to a notion that is the "negative of the conceivable itself?" It is wonderful that so great a mind as that of Sir William Hamilton could have fallen into so grave and palpable a contradiction. But, to quote further, he says: "The conditioned is the mean between two extremes, two inconditionates, exclusive of each other, neither of which can be conceived as possible, but of which, on the principles of contradiction and excluded middle, one must be admitted as necessary." Can any thing be more wonderful than that so great a logician should thus apply a law of logic to prove that which this same law condemns as impossible? Can anything be more absurd than to hold that the law of the mind requires it to admit

as necessary truth that of which it cannot possibly conceive, and which is contradicted by its conception? Sir William Hamilton himself seems to have had a suspicion of this, for he declares that "by a wonderful revelation we are thus, in the very consciousness of our inability to conceive ought above the relative and finite, inspired with the belief in the existence of something unconditioned beyond the sphere of all comprehensible reality," which simply means that Sir William Hamilton, after having made a mistake in his application of the law of thought, whereby he had proved that infinite and absolute Being could not be, still could not rid himself, as others claimed to have done, of the conviction that there is such Being.

The quotations from Mr. Mansel are from his "Limitations of Religious Thought," and we copy: "The very conception of consciousness, in whatever mode it may be manifested, necessarily implies distinction between one object and another. To be conscious, we must be conscious of some thing, and some thing can only be known as that which it is by being distinguished from that which it is not. But distinction is necessarily limitation; for, if one object is to be distinguished from another, it must not possess some form which the other has. But it is obvious the infinite cannot be distinguished as such, from the finite by the absence of any quality the finite possesses, for such absence would be a limitation, Nor yet can it be distinguished by the presence of an attribute which the finite has not, for, as no finite part can be a constituent of an infinite whole, this differential characteristic must itself be infinite, and must at the same time have nothing in common with the finite. We are thus thrown back upon our former impossibility; for this second infinite will be distinguished from the first by the absence of qualities which the latter possesses. Consciousness of the Infinite, as such, thus necessarily involves a self-contradiction, for it implies the recognition of a limitation and difference of that which can be given only as unlimited and indifferent." This only proves that Mr. Mansel has wholly mistaken the nature of the conception he is discussing, holding that it must be something different from any thing that can be; and his mistake has led into a self-contradiction, which ought to have been sufficient to have warned him of his error. But to extricate himself he proceeds thus: "This contradiction, which is utterly inexplicable on the supposition that the Infinite is a positive object of human thought, is at once accounted for when it is regarded as the mere negation of thought. If all thought is limitation—if what we conceive is, by the very act of conception, regarded as finite, the Infinite, from a human point of view, is merely a name for the absence of those conditions under which thought is possible." That is to say in plain language, there is no Infinite; it is nothing. Yet Mr. Mansel holds that we are compelled by the conditions of our minds to believe in the existence of the Infinite, as the complement of our consciousness of the finite; whereby he falls into the same absurdity that characterized the reasoning of Sir William Hamilton.

To these proofs of an unknowable, such as they are, which Mr. Spencer approves, he adds one of his own. His says: "Every complete act of conscious-

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ness, besides distinction and relation, also implies likeness. Before it can become an idea, or constitute a piece of knowledge, a mental state must not only be known as separate in kind from certain foregoing states to which it is known as related by succession, but it must be known as of the same kind with certain foregoing states." Not to quote unnecessarily, this doctrine is, that ideas, to be ideas, must be classified; and he adds that "a true cognition is possible only through an accompanying recognition"—that is, a recognition of preceding cognitions with which it may be classed. This Mr. Spencer foresees commits him to the absurdity of an unclassable first cognition, which is here held by him to be impossible; in view of which, according to this doctrine, there can be no cognition at all, and thought and knowledge are shown to be impossible. But he endeavors to extricate himself from this predicament by the argument "that cognition proper arises gradually, that during the first stage of incipient intelligence, before the feelings produced by intercourse with the outer world have been put in order, there are no cognitions, strictly so-called; and that, as every infant shows us, these slowly emerge out of the confusion of unfolding consciousness as fast as the experiences are arranged in groups." Here it is sufficient to point out, that as no cognition can be according to this doctrine, until there is a preceding cognition sufficiently definite to class it with, the argument does not extricate him from the absurdity, however gradual the process may be. But the argument concerning the infinite, and the absolute as well, which he bases upon these fallacious premises, is: "The First Cause, the Infinite, the Absolute, to be known at all, must be classed. To be positively thought of, it must be thought of as such or such—as of this or that kind. Can it be like in kind to anything of which we have sensible experience? Obviously not. Between the creating and created there must be a distinction transcending any of the distinctions existing between any of the divisions of the created." This doctrine of the necessity of classification, as a prerequisite to cognition, is one of Mr. Spencer's psychological doctrines, the validity of which will be examined in the proper place in these papers; suffice it to say for the present, that if it be true, we have no conception of Time nor Space, neither of which can be conceived as like any other thing in the universe. But inasmuch as we know certainly that we have conception of Time and Space, the argument does not prove that a conception of the Infinite is any less possible.

In regard to these three doctrines upon this subject, it must be remarked that when we find our reasoning results in self-contradictions, it is not safe to conclude that reason is mendacious until we shall have proved that we have not erred in the application of its laws. Such an occurrence should suggest to us the necessity of proving our process; as the school boy, when his multiplication fails to bring the answer laid down in his text book, proves his process by a division; and as he assumes that the error is in his process, and not in his book, so may we safely assume that the error is in our process and not in the constitution of the mind.

If thus we find the doctrines of these great thinkers to be, upon this subject, contradictory and absurd, we may safely suspect that they have erred in their

process, and proceed to look elsewhere for the truth. That which has the appearance of truth, in this particular, lies patent on the face of things, and it seems wonderful that trained and thinking minds should have overlooked it. It may be formulated thus: Whatever exists within the scope of our conceptions, that we can conceive as bounded only by itself, and which is not wholly embraced within our conceptions, must be held to be infinite; and that part of which we can conceive symbolizes to us that of which we cannot. An illustration will make this clear. Space and Time, and Quantity in its abstract sense, have been held by all thinkers and all mankind to be infinite. We can conceive of no Space as bounded without at the same time conceiving that there is other Space beyond the boundary. We can conceive of no Time as bounded, neither past nor future, without at the same time conceiving that there is other Time beyond the boundary. We can conceive of no Quantity so great that it might not be greater and if none so small that it might not be less. Our conceptions cannot entertain any limits to any of these, except it be limits imposed by the same thing lying beyond the limitations; yet our conceptions will not embrace the unlimited. Mr. Spencer gets a faint shadow of this idea, and holds that we, of necessity, construct a mental symbol for the infinite and absolute which stands for it in our conceptions as the correlate of the finite; and he thus presents the best possible criticism upon his own doctrine, above quoted, for such symbol is certainly unclassed and unclassable. But from this idea of a symbol, which is a true idea, he falls into the surprising error of declaring that we should treat such symbolic notion as utterly without resemblance to that for which it stands." Now, as the Space, Time and Quantity which we conceive to lie beyond the uttermost grasp of our conceptions, can be conceived only as being exactly like the Space, Time and Quantity lying within our conceptions, it follows that, if we treat that within as a symbol for that without, we must not only not regard our symbol as utterly unlike that for which it stands, but the conditions of consciousness leave us no choice but to conceive it as exactly like that for which it stands. Thus, as the Space, Time and Quantity within our conceptions stands as a correct and truthful representation of the Infinite Space, Time and Quantity, beyond they show us how our formula makes infinity comprehensible.

In regard to the Absolute, we need not quote so extensively from these great thinkers as we have done in regard to the Infinite; yet we must make a few extracts from their doctrines. Mr. Mansel writes: "A second characteristic of consciousness is that it is only possible in the form of a relation. There must be a subject or person conscious, and an object, or thing of which he is conscious * *. The destruction of either is the destruction of consciousness itself. * * * To be conscious of the Absolute, as such, we must know that an object which is given in relation to our consciousness is identical with one, which exists in its own nature out of all relation to consciousness; but to know this identity, we must be able to compare the two together; and such a comparison is itself a contradiction. We are, in fact, required to compare that of which we are conscious

with that of which we are not conscious; the comparison being an act of consciousness, and only possible through the consciousness of both its objects." To escape this contradiction, Mr. Mansel has recourse to the same absurdity into which he fell in discussing the Infinite—that the Absolute is merely the negation of a conception. He writes: "The Absolute is a term expressing no object of thought, but a denial of the relation by which thought is constituted." But this he holds "does not imply that the Absolute cannot exist; but it implies, most certainly, that we cannot conceive it as existing." Yet he holds that "we are compelled, by the constitution of our minds, to believe in the existence of the absolute Being—a belief which appears forced upon us as the complement of our consciousness of the relative and the finite." In this again he represents the mind as under the necessity of believing in the existence of that which his interpretation of its laws shows that it must declare does not exist.

Sir William Hamilton holds a like view, and falls into a like contradictory absurdity, which he expresses thus: "The absolute is conceived merely by a negation of conceivability," which represents the mind, as he did in discussing the Infinite, as acting without the conditions within which alone its action is possible.

Mr. Spencer apprehends an error in Mr. Mansel and Sir William Hamilton in the quotation he makes from them concerning the Absolute, and he seeks to correct it with an explanation of his own, more consistent in character but to the same effect. He holds, in opposition to them, that consciousness of the Absolute is positive and not negative, and that such a conception is constituted, not by any single mental act, but by many. He says: "In each concept there is an element which persists. * * * The persistence of this element, under successive conditions, necessitates a sense of it as distinguished from the conditions, and independent of them." This sense of it he holds to be an indefinite consciousness, "constituted by combining successive concepts deprived of their limits and conditions." Were it possible for us thus to deprive our concepts of their limits and conditions, so as to combine them, it must be observed that, since concepts are constituted of limits and conditions, the process would deprive us of the concepts, and thus render such combination impossible.

This doctrine of an indefinite consciousness upsets another of Mr. Spencer's psychological doctrines, wherein he holds that consciousness is the product of definite mental changes, without which it is impossible. Conflicting as this does with the nature of concepts, and with Mr. Spencer's own doctrine concerning the character of consciousness, it comes close to a great truth, which he approaches still closer in comparing this notion of the conception of the Absolute to the notion of Time and Space beyond the limits of consciousness. He says: "Though not contemplated as definite, it is yet contemplated as real," and "which, though we do not form of its concepts proper, since we do not bring it into bounds, it is yet in our minds the undeveloped material of a conception." But instead of shaping this undeveloped material into a conception, he disappoints us by

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holding that, while thus "the momentum of thought inevitably carries us beyond conditioned existence to an unconditioned existence," "that ever persists in us as the body of a thought, we give it no shape;" and, in another place, he holds that we cannot shape it into a thought.

Here may be included also the doctrines of Kant on this subject, which seem to have been adopted by Sir William Hamilton and Mr. Mansel, and to the ultimate conclusion of which, of an Unknowable, Mr. Spencer subscribes, while rejecting his argument. He found substantially the same self contradiction in thought when approaching the Absolute that we have seen in Sir William Hamilton and Mr. Mansel, the opposing factors of which he presented as natural antinomies, between which thought expires before reaching a conception concerning the absolute.

That all such self-contradictions must be false, seems self-evident. It is hardly believable that the mind contains within itself the elements of self-destruction; and we ought to find for the Absolute, as for the Infinite, some reasonable explanation. In the first place, it must be observed, as a truth taught by all these dinguished philosophers, that alleged Being, without aspects by which it may be known, cannot be held by the mind to be Being at all; but it is necessarily held to be nonenity. Man has no guide in philosophy save his own reason; from its dicta there is no appeal. Hence, when it is attempted to present to his conception Being without relations, characteristics, aspects, or attributes by which it may be known, the conditions of consciousness leave him no choice; he must declare such attempted representation of Being to be nothing. The doctrines here quoted from the most distinguished thinkers of modern times abundantly illustrate this fact.

Yet that there is Absolute Being, without relations, is recognized by most philosophers and by all of mankind who have projected thought into these altitudes. Its existence is recognized by the four great thinkers whom we have quoted, although their misapplication of the laws of reason and their consequent self-contradictions present a conception of it which the mind must regard as not Being at all but as nonenity. What then can be presented as Absolute Being? If we adopt the old idea of the unity of Nature we shall find that it helps us to a reasonable conception; it presents us all Being as the Absolute, which is also necessarily conceived to be the Infinite. It is being taken as a whole, and hence is not a supreme or chief being, not the active aspect or the passive aspect of Nature, not the energy it manifest nor the substance upon which energy is exerted. It is both; it is all. As such it is infinite and without relations to other being, for there is no other between which and itself there can be a relation even of difference. It is thus necessarily self-existent, and self-regulative. As a whole it is independent, while its parts are dependent upon the whole. It is true that man's conceptive powers will not embrace so stupendous a whole, but he must and always has conceived that there is such a whole. Relations are the characteristics of its parts, and its parts are reliable symbols of the whole, for a part can only

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be conceived as implying that of which it is a part. Yet, Mr. Mansel writes: "We can have no consciousness of Being in general which is not some being in particular;" which, instead of showing, as he holds, that it "must be one thing out of many," only discloses to us that condition of consciousness which compels us to conceive the Absolute as individual. Thus, instead of being compelled, by a law of the mind, to accept as truth a self-contradiction, as held by Sir William Hamilton; and instead of being under duty "to think of God as personal" and "to believe him infinite," in the face of doctrines which show that we can do neither, as held by Mr. Mansel; we find that the conditions of consciousness leave us no choice but to conceive the Absolute and Infinite as individual. The conclusions of these philosophers show that, though we may blind ourselves with misconception and error, we still cannot escape this necessity. And here we see, without raising any question concerning revelation, that the Infinite and Absolute has so hedged around our minds as to make a failure to perceive it an impossibility. That the only conception of the Absolute that can be formulated is the one here presented is shown, not only by the fact that all others fall into self contradiction and absurdity, but also by the fact that it is a necessary product of our consciousness.

From the conception of absolute and infinite Being here presented, it follows as a necessary conclusion, that the laws we find prevailing around us, are of its production; either as a whole or in some of its aspects, and their constant enforcement are the expression of its potency. As law can be conceived only as the product of intelligence and its enforcement as the expression of Will, this conception demonstrates to us that, so far as Intelligence and Will are concerned, our former deductions are not only legitimate, but are the necessary product of consciousness. As law can be conceived only as expressing the nature from which it proceeds, and as we find laws expressing an emotional nature, we are left no choice but to conceive the Absolute and Infinite as an emotional Being. Intelligence, Will and Emotion, are found only in combination, and only when attended with Consciousness; and as these four constitute Personality we have no choice but to conceive the Infinite and Absolute as Personal.

But how can such a conception as this reconcile the existence of the Absolute and Infinite with the existence of the relative and finite? How can a conception of the existenc of one sole Being be reconciled with the multiplied forms of concrete Being, with which we are so familiar? This brings us face to face with a third great problem of philosophy, which has been discussed since the days of Aristotle, and about which volumes of elaborate error have been written, besides the fallacies of Mr. Spencer on this subject. This problem is no less than the relation of Subject and Object. Here we need not quote from the elaborate former discussions; a statement of what appears to be manifest truth, lying openly on the face of things, will we believe be found to make it so plain and comprehensible as to leave no room for discussion. Upon this subject, it must be observed, that past error has arisen from a misconception of what

is embraced under these two terms. The Subjective state has been defined as an active state, and the Objective state has been defined as a passive state. Hence the evolutionists have conceived the activity by which life is manifested to be the result of interaction between dynamic forces external to the living organism and static, or passive forces within; thus reducing man to a mere mechanical automaton, caused, manipulated and mollified by external forces, for the existence of which their philosophy can give no account. Now, the Subjective state is not an *active* state, but it is an *acting* state; the Objective, in relation to its own Subjective, is always passive, is always the recipient of acting power, and hence is always, within itself, in an active changing condition. The Subjective state is one of constancy and unchange; the Objective is one of inconstancy and change. To illustrate:—Man, in his Subjective, acting state, has himself as the object of his activity; he may determine to become something else than what he is—to become more learned, or more refined, or more moral; or he may determine to remove himself bodily from the place he is in to another. From his Subjective state proceeds, along with such determinations, the *acting* by which the result is to be brought about; and this *acting*, in reaching his Objective state, sets up the activity and change by which the determined result is realized. The Subjective aspect of man lies deep in his nature. It is revealed not directly and in itself but indirectly and in what it does. It is the soul: Thought, Will, Emotion, Imagination and Preception are its immediate manifestations and together with the physical body constitute the Objective Aspect. This is man's primary Objective; Nature as Objective to him being so secondarily.

Now to apply this doctrine and illustration to the infinite and absolute Being who we have seen is necessarily the sole Being in the universe. In its aspect as a stupendous whole, it presents the Subjective state, for, manifestly, a sole being that fills all space cannot be conceived as a changeable aggregate, nor as Objective to aught save itself, in respect to being made to act. It can be conceived only as eternally constant, eternally unchanged by any other. But in its aspect as Objective to itself, the *acting* proceeding from its Subjective aspect, produces a state of activity and continual change within itself. Hence arises the concrete, changing forms with which our observation and science make us so familiar. This Subjective, constant, acting aspect we call God; and this Objective, inconstant, active changing state we call Nature. The

> —"poor Indian, whose untutored mind,
> Sees God in the cloud and hears him in the wind."

has a great truth, which to formulate and explain, would make a modern philosopher immortal.

Thus we find that this conception of the Infinite and Absolute yields us, on the one hand, a conception of an acting constant immutable principle, which is the source of all the activity we see around us and which we call God. The activity we see reveals to us the laws by which it proceeds, which are the express-

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ions of the attributes of the acting principle. The attributes thus revealed to us we find to be immutable; and they also symbolize to us the principle to which they belong, which is thus made knowable and known to the extent that we know them. On the other hand, it gives us a conception of a dependent active and changing form which we call Nature, and which is but the expression of the independent acting principle. It thus validates to reason the doctrine of a personal spiritual God, and it teaches the eternity of nature. Does not this make the Infinite and Absolute knowable to us, as well as the limited and relationals

If we may entertain such a conception of the Infinite and Absolute, as it seems that we must, it dissipates all the sensation and ideal philosophies of the present and the past. It corrects the errors of the erring, some of whom have endeavored to teach mankind that there is no God, and some of whom have endeavored to teach that there is no Nature. We find also that it purges philosophy of its contradictions; and it relieves science of its shadows of uncertainty, for it shows it to rest upon an immutable foundation; and that the phenomena which constitutes its data is the expression of Immutability and not the product of insensate and varying forces, whose existence is unaccountable. The immutable laws underlying the phenomena with which science is concerned reveals to us the immutable attributes of God upon which they are founded. These attributes, like the Principal to whom they belong, are infinite and apply everywhere alike throughout the sphere of their applicability. In this paper we are concerned with but three.

The first of these is that by which effects in the Physical World, and Consequences in the Moral, are exactly proportioned to Causes. In the Moral World we call it Justice. In the domain of physical law, as we well know, effect inevitably follows cause. Here the only escape from the effects of violation is in invoking the action of some law other than the one violated. So in the domain of moral law; for here, as in the physical, we have but to invoke a law other than the one violated, to escape the consequence of violation. This may be done with ease, almost without knowledge, and by each person for itself; by the most lowly and ignorant equally with the most lofty and learned. In the moral, as in the physical, the violation of law brings pain, which suggests the need of remedy; and the experience of mankind shows that, in the moral, we have but to grieve for our offense, turn from the offending course, and resolve upon obedience to the law of our own natures, and the pain disappears and peace and strength come into the soul. This remedy requires no aid from man, and no elaborate knowledge; whereas, in the domain of the physical, the remedy usually requires the intervention of another, and often demands great knowledge. This brings to our view an Attribute which, while not in conflict but perfectly consistent with Justice can be interpreted only as an expression of Mercy for weak and erring sentient beings. Obedience brings, as its reward, the highest beatitude of which man can conceive, while disobedience brings his intensest pain. The existence of such wise and adequate provision for man's moral welfare can not be conceived as

springing from one who cares not for him. On the contrary, it reveals to us a Love for us of no mean degree, existing prior to our being. These attributes, like the Principal to whom they belong, must be conceived as positive and immutable; and on our part, they call for obedience to law, which is righteousness; and for a responsive love and gratitude toward Him from whom we receive such blessings, which is positive worship; and for a reflection of like attributes toward our fellows, which is positive virtue and humanity. And though the obedience to law may seem to require self-denial and pain, it is not really so; for the state of feeling from which obedience proceeds, raises the soul above the sense of such things, as all know who have obeyed in spirit as well as in name. Nay more, it mitigates the keener sense of physical pain, as is now explained by science and as is shown by the history of martyrs and the Cross. This is the essence of the highest Religion, which this conception of the Absolute and Infinite relieves of that unbelief which has corrupted our morals and degraded our social relations. Religion is thus shown to be, not a matter of faith alone; not validated to us by the dicta of the church alone, and not alone by the Divine Founder of the church; but as a matter of positive knowledge, validated by our own reason, which shows it to be a necessary product of consciousness, founded upon the infinite and immutable attributes of an Infinite, Immutable and Eternal God.

MEDICINE AND HYGIENE.

GOOD EYES AND FREE SCHOOLS.

BY JOHN FEE, M. D.

The idea, that the existence of free schools, in a country, is the evidence of a perfect civilization, has become so deeply rooted, that he who would contradict it, would subject himself to public reproach. Cheerfully accepting this public sentiment as a self-evident proposition, let us ask: is the highest state of civilization inimical to the physical or bodily welfare of mankind? In reply, we say yes, in one respect only, namely, in its effects on vision. Otherwise civilization is a perfect boon. The most highly civilized communities furnish the best specimens of beauty, of symmetry, and of strength and endurance.

Civilized man has a power of adaptation unknown to the savage and barbarian. He can endure the heat of the torrid zone as well as the African negro, and the extreme cold of the pole equal to the Esquimaux. It is a fact, however, that our public school system, while it is the corner stone of our republican institutions, is inflicting, as conducted, a great injury on the vision of the rising generation and laying the foundation of a mental and physical misfortune to

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future generations. What the extent is of this deformity, can only be calculated by the value of the eyes as avenues of the soul.

If total blindness is an indescribable calamity to the few, how much of a national calamity is that which narrows its field of vision down to a few inches, and shuts out forever the beauties of landscape and sky? The infliction of such wholesale misery is the mission of a higher education, as at present acquired, and the public school room is the popular instrument of its successful production. We are very particular to assert, however, that the successful pursuit of this higher scholarship does not, necessarily, require the sacrifice of perfect vision, or the enfeebling of that instrument of the mind that affords the most pleasure and instruction.

To state our accusation plainly, we assert that the eyes of school children are undergoing a change of form whereby they are impaired as optical instruments, and that this deformity will, in time, become a regular and constant factor, fixed by the laws of heredity, so that what is now known as a deformed eye will be the normal eye. Let us illustrate: The normal eye is spherical in form, its axis or antero posterior diameter is about one inch in length, and its width, generally, one-twelfth of an inch shorter than its length or axis. Its lens system, or cornea and crystalline lens, have such a focal distance that when the eye is fixed on an object more than twenty feet distant an image should be formed at the center of the eye, on the retina, without any effort at accommodation. When this is the case the axis of the eye and the lens system are said to correspond and the eye is normal. Our present system of school instruction destroys this perfection of the eye, so that when a child has gone through the grammar school, and is ready for the high school, there is in many individuals, such a lengthening of the axis of the eye that no object can be brought to a focus, unless it is brought up close to the face of the observer, and the person is said to be near sighted or myopic. We find then, that, although, the pupil entered the school room with a spherical eye, during a few years of school life the eye has undergone a change, in which its length has been disproportionately increased and the eye has bulged backward, so that its focus is in front of the retina. This change has, obviously, been caused by continuous convergence of the eyes in the effort to bring to a focus rays of light from small print. This surrender of visual health for education is not made exclusively by the children of this country; it is a tribute paid in all countries, where a higher mental development has been demanded. We get as proof from foreign lands the following figures: Vienna—near-sightedness, from 33 per cent. in the lowest grades of the school room to 60 per cent. in the highest. Breslau—myopes in the city schools—first grade 6.7 per cent.; second grade 10.5 per cent. In the normal schools 19.7 per cent.; in the gymnasia 26.2 per cent. At Königsburg the percentage of myopia is 11.1 in the lowest grade, and the enormous amount of 62.10 per cent. in the highest. In St. Petersburg 13.6 per cent. in the lowest grade and 43.3 per cent. in the highest. At Lucerne the rise of near-sightedness in pupils from seven to twenty-one years is from 0 to 61.5 per cent.

For statistics of foreign schools I copy from Dr. E. G. Loring's pamphlet, "Is the Human Eye Changing its Form under the Influence of Modern Education," New York, 1878.

Let us now turn to the researches in schools of the United States. Cincinnati, 630 students examined: District schools, near-sighted 10 per cent.; intermediate, 14 per cent.; normal and high, 16 per cent. Brooklyn Polytechnic, 300 students: Academic department, 10 per cent.; collegiate, 28 per cent. Buffalo Public Schools, 1,003 pupils: The percentage of near-sightedness increased from 5 per cent. at seven years of age, to 26 per cent. at eighteen years. It was further ascertained that one of every four graduates of the Buffalo high school was near-sighted. In New York a careful and exact examination of 2,265 pupils by Drs. Derby and Loring showed the existence of near-sightedness of 3.5 per cent. in children from six to seven years of age, with an increase of 26.78 per cent. in students from twenty to twenty-one years of age, an increase of over seven-fold. At Dayton an examination of 765 pupils gave the following results: Myopia in the district schools, 15.35 per cent.; in the intermediate, 17.65 per cent.; in the high schools, 18.32 per cent.

For statistics of schools of this country, I am indebted to Dr. W. J. Conklin's pamphlet entitled, "The Influence of School Life upon the Eye-Sight with Special Reference to the Public Schools of Dayton."

From the above statistical facts we learn that we are following fast the example of the "effete cities of the old world"(?) in our success in impairing the visual apparatus of our children, and we only lack time and more constancy of habit on on the part of our people, so that the laws of heredity may implant this visual deformity, permanently, into the race. Let us now inquire where there is a remedy for this forboding evil. Most writers on this subject have attributed this loss of vision to the following causes: Defective illumination of school buildings; uncomfortable and faultily constructed seats; insufficient nourishment and the vitiated atmosphere of the school room; too many studies and continuous attention to books. I am free to confess that these faults are auxiliary causes of near-sightedness; but they do not form the ground work of the malady. In this country, the buildings are generally well lighted, and the seats of the school room have been manufactured with due regard to the comfort and health of the pupils. Nor can we admit that the children are not sufficiently fed. As to the number of studies, these, generally, come at an age when near-sightedness could not be easily produced, when it either already exists to a considerable extent, or will not be developed, but can be intensified, if existing. We believe the cause of myopia to be the convergence and accommodation of the eye for small print. It is true that the eye of a child is a perfect optical instrument and has the greatest functional activity, but this very perfectness is a something that ought to be held in reserve. The constant strain on the eye for convergence compresses its coats, impairs its nutrition, weakens the resistance of the sclerotic until its spher icity is changed, and gives place to an elongated axis and myopia. The remedy,

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then, is in abandoning the primer and books for the first grades of the school room. Instead of these, use books printed on whole sheets of paper, in type as large as those used for posters. These books could contain the alphabet and spelling lessons of two to four syllables, also the elementary lessons of arithmetic and geography, and should be hung up against the wall of the school room, and owned by the city and township organizations. The letters would be so large that they could be seen at any distance within the school room, and would be considered at an infinite distance, so that the pencils of light from them would be practically parallel, and would require neither accommodation or convergence in order to bring them to a focus.

Such an arrangement would enable the pupils to get their lessons and recite them without leaving their seats and without straining their eyes. The rule no convergence and no accommodation for the eye, for the first and second grades, should be absolute. For the subsequent grades there should be a like improvement in the typography of the text books.

The letters should be large so as to be brought easily to a focus and to make large images on the retina. The same object should be secured in the text books of the high school, and the largest text now used should take the place of notes and explanations, and correspondingly larger letters should be used for the general text. I am firmly convinced that these suggestions contain the corrective for the increasing deformity of near-sightedness. Every year brings a higher standard of scholarship into our public schools, and demands increased application and time to text books, so that with the menace of impaired vision comes the responsibility of so controlling the youthful studies, that with the patrimony of a well stored intellect, there shall not come a groping darkness as the penalty of nature's violated law.

SCIENTIFIC MISCELLANY.

RAMBLES OF A NATURALIST AROUND KANSAS CITY.

No. 2.

BY WM. H. R. LYKINS.

Out across the great bridge spanning the Missouri—out into the cool and quiet shadows resting on the clean yellow sands—is a pleasant change from the thronged and dusty streets of the busy city. The south wind murmurs pleasantly through the tall tree tops, and the air is fragrant with the perfume, not of flowers—but of a fungus. A small white mushroom, growing upon dead trees, evolves from the decaying timber a pleasant odor something like that of a ripe May apple (*podophyllum*). Persons wandering through the woods often meet with the

scent of this vegetable, but are not aware of the source from whence it comes, thinking that it is the perfume of some wild flower. This large and curious race of vegetation (the fungi) has met with but little attention from naturalists in this country. A contemptuous kick, and the epithet of "toadstool" is generally the best treatment they receive. Yet, in these lowly forms are many of rare beauty of color and delicacy of organization, many valuable for their medicinal qualities, and many prized by epicures as an esculent. The difficulty of keeping them after being gathered, and the poisonous qualities of some, are the principal causes of this neglect. But while some are pleasant to the eye and taste, others are of a directly opposite nature. In an old meadow in this vicinity we once met with a fine specimen of the *Phalloidei*—well named *impudicus*, a curious freak of nature which once seen or *smelt* can never be forgotton. It is of round, obelisk form, about eight inches in height, and from a hole in the top exudes a greenish fluid which has the smell of putrid flesh, scenting the air with its disgusting odor for many rods in its vicinity. Fortunately they are not plentiful, or they would be an unmitigated nuisance. The Cottonwood (*Populus Canadensis*) is par excellence the pioneer of vegetation. Its light cottony seeds are borne far and wide by the winds, and wherever they can find a lodgment they take root and flourish. Let but a tiny strip of sand bar show its surface above the water and it is preëmpted by the Cottonwood and its humble companion the willow (*salix longifolia*). Their foliage arrests the wind-drifted sands, the ground rises around them, and soon another island is wrested from the river. Far out on the plains in lonely ravines and on barren hillsides this tree may be found bravely battling with the elements of wind, fire and lightning, and though often scarred and broken, it generally manages to hold its ground. Then the birds come and rest in its branches, bringing other seeds, and soon a little grove springs up around it, overshadowing a pool of water—a veritable oasis in the desert. Although its timber is not as lasting and useful as the pine, it is an excellent substitute on the prairies of the West. It is of quick growth, attains a large size and may be planted aud utilized while more lasting timber of slower growth is coming on. The young shoots and buds are excellent food for cattle and horses, and the Indians often save their ponies in hard winters by driving them into cottonwood bottoms and felling the young trees for them to feed upon. But the insatiable demands of civilization are fast using up the noble cottonwood forests of our river bottoms, denuding the banks of their protecting care and leaving them a prey to the ravages of the current.

Crossing the bottom, scarred and seared with the traces of the great flood of 1844, when the Missouri resumed its ancient bed and ran from bluff to bluff, twenty feet deep on these low lands, we come to the hills on the northern side. At the extreme foot of these hills the collector will find a layer of shale from which many good specimens of fossil ferns of various species can be obtained.

The shale is rather soft and must be carefully dried in the shade, then painted with some light transparent varnish to save the specimens in good condition. A

great variety of trees clothe these hillsides—oaks, hickory, walnut, ash, hackberry, linn, maple and many others of smaller growth; and if you would see a living chromo, painted in all the gorgeous and unerring tints of nature, come here when the first frosts of autumn have colored their foliage with crimson and gold, blue, brown and purple, and you will see one of rare beauty and excellence.

As one stands upon the top of these bluffs and looks down upon the great valley below, with the great river winding through it like a silver thread, he is lost in the contemplation of the vast time it must have taken to carve out this great water course, hundreds of feet deep, through masses of rock, shale and clay. But to the observer of Nature's methods the process is plain and simple. Stand here when the last snows of winter are melting off under the influence of a hot afternoon sun and you will find every atom of this hillside in motion. Thousands of tiny streams and rivulets loaded with sediment are hurrying downward, great cliffs are undermined and plunge down the slope, carrying with them tons of loose rock and earth. By this process and the thawing out of the frost the surface is left in a soft and spongy condition; then comes a sudden thunder shower with its torrents of water, sweeping all this loose material into the river to be scattered along on a thousand sand bars; to be triturated and ground up by the swift current, and finally swept out into the great ocean to build up new continents and new worlds. And when you remember that this work has been going on for ages and ages, as constant as the rising and setting of the sun, you can easily imagine how these great valleys have been scooped out and widened in the process of time.

We stand now in the angle of what is called the great bend of the Missouri. This noble river heading far up in the mountains in the northwest, after a southeasterly course of nearly two thousand miles, here makes a sudden turn to the east. On either hand of us is the valley of the Missouri, with its bold headlands stretching far away in the distance, in front to the south, is the broad valley of the Kansas. It is a place to attract the lover of the sublime and beautiful in Nature. But others have been here long ages before us. Around us in the shadow of these great trees are the mounds of the dead—"traces of lost and forgotten races." These mounds are generally placed in groups of three. Some are mere heaps of earth over a few calcined human bones, while others have within them a square, walled chamber with an opening to the South in which the bodies were laid in regular order. One large mound, which the writer assisted in opening, contained only a single skeleton which had apparently been placed in a sitting position. It was that of a huge-limbed, low-browed savage, probably such an one as Gen. Mitchell describes in his "Three Expeditions in the Interior of Australia." He says: "As I was reconnoitering the ground for a camp, I observed a native on the opposite bank, and without being seen by him, I stood awhile to watch the movements of a savage man 'at home.' His hands were ready to seize, his teeth to eat, any living thing; his step, light and noiseless as that of a shadow, gave no intimation of his approach; his walk suggested the

idea of the prowling of a beast of prey. Every little track or impression left on the earth by the lower animals caught his keen eye. The wind blew cold and keenly through the lofty trees on the margin of the river, yet that broad, brawny savage was entirely naked. Had I been unarmed I had much rather have met a lion than this sinewy biped." One chambered mound which we opened was filled with alternating layers of wood charcoal and burned human bones, as though a number of human bodies had been burned at the same time; perhaps the wives and slaves of some mighty chieftain sacrificed at his burial to attend him in the other world. What awful rites of human sacrifice or cannibal feasts have been enacted on these lofty hills, accompanied with the shouts and songs of the savage hosts and the smothered groans and screams of the victims as the blazing fires lit up the dark forests below and gleamed out over the rolling waters, we may never know. Nothing is left to tell who they were, whence they came or how they passed away. These mounds are scattered along the bluffs for miles up and down the river. They are doubtless of great age, perhaps as old as the time when the river was yet cutting a new channel through the great deposit of Loess which once filled this valley. It is a puzzle to account for the fact that in some of these mounds of apparently the same age and construction the burials have been so different; in some the bones being burned, in others, in a natural condition. In none of them have any implements of stone or pottery been found, which is evidence of their great antiquity.

FIRE-RESISTING POWER OF BUILDING MATERIALS.

According to experiments made by Dr. Cutting, State geologist of Vermont, with regard to the resisting power of building stones to fire, no known natural stone used for building purposes can be called fire-proof. Conglomerates and slates yield readily to the action of heat, and granite is injured beyond cheap and easy repair by a heat that would melt lead. Among the best resisting stones are the brown sandstone, used so largely in New York for fronts. Limestones and marbles are even better than these, but a heat of from 900° to 1200° is sufficient to calcine them at last into quicklime. In short, most stone buildings are as much damaged by fire as wooden structures are. Brick is, however, rather improved by heat, until the heat is sufficient to vitrify it. Dr. Cutting recommends brick, with soapstone trimmings, as the most fire-proof materials which can be used in buildings.

WATERPROOF CEMENT.

Dissolve guttapercha in bisulphide of carbon so as to form a syrupy mass. Apply this warm to the two surfaces to be joined, and dry if possible under pressure. Another: Guttapercha, 1 lb.; india rubber, 4 oz.; shellac, 1 oz.; linseed oil, 1 oz. Melt the materials together. The mass becomes solid on keeping, and must be melted before application.

BOOK NOTICES.

CONTRIBUTIONS TO PALÆONTOLOGY, Nos. 2–8: By C. A. White, M. D.: Extracted from 12th Annual Report of U. S. Geological Surveys of Territories. printed July, 1880. Text 171 pages, plates 42.

This is one among the most valuable contributions to Palæontology yet issued from the Government printing office.

The plates are well executed and from my own observation are faithful copies of the organic remains figured, and embrace 18 plates of Cretaceous, 1 of Tertiary, 11 Laramie, 2 Triassic, 4 Carboniferous, 2 Jurassic, 3 of Sub-carboniferous and 1 of Coal Measure fossils.

As the Carboniferous and Coal Measure fossils interest us most, I will briefly note their descriptions.

Pl. 36, fig. 1, *Productus giganteus*. The figure calls to mind that this well known European fossil, from the mountain limestone of England and Russia, has heretofore been unknown in America. The figured specimen was collected by M. L. Kumlein, of U. S. fish commission, from the valley of McCloud river, Shasta Co., Cal. The transverse diameter of specimen measured five and a half inches across the hinge border. Its associated fossils were typical carboniferous (coal measure) fossils. Prof. White says that it is remarkable that this fossil has only been found on the western border of the continent and not the eastern. We know that most of the central portion and eastern border have becn carefully looked over for new fossils and rare ones.

Plates 39 and 40 are of sub-carboniferous fossils, chiefly corals obtained from the top beds of what is known in Missouri geology as the Chouteau limestone, most of them being new and very interesting species. Some are from Iowa, but they are chiefly from Sedalia, Mo. *Michilenia placenta* White, *Michelinia expansa* White, *Chonophyllum*] *Sedalience* White and *Lithostrotion Mycrostytum* White, were obtained from Sedalia and are all new species. Others found in the same rocks at Sedalia, which have also been elsewhere found and here figured, are *Lophophyllum expansum*, *Hadrophyllum glans*, *Zaphreutis Calceola*, *Z. elliptica.*

These fossils were chiefly obtained from a buff or drab shale at the top of the Chouteau limestone and just beneath the Burlington limestone. I have also occasionally found them lying loose on the hills of Pettis, Benton, St. Clair and Cedar counties, and they may also, probably, be found in other counties of South Missouri.

The best locality for finding these corals at Sedalia was an apparently limited area now exhausted. The Zaphreutiform corals can still be obtained there. I had noticed this peculiarly interesting locality at Sedalia five years ago, and at that time obtained some very fine specimens from the quarries. The thick brownish-gray Burlington beds appear in fragmentary strata overlaid in most places by broken

chert masses, some worn, as if drifted, but other beds are apparently broken in places, and from them some good fossils can be obtained.

Prof. White speaks of the hitherto frequent occurrence of the *Zaphreutidæ* in the Kinderhook and Burlington and Keokuk groups, and of the hitherto comparative absence of other forms, the *Lithostrotion Mammillare* only having been hitherto found.

Dr. White says "the discovery of four new forms of Actinoid corals is a matter of much interest, and the interest is also increased by the fact that they are all types which are unusual in at least American carboniferous strata." Dr. White says conclusively "that such a group of corals is not without a certain Devonian facies."

The vertical range of these corals is small, indicating the short period of the age during the formation of the reef. It is certainly a well marked horizon.

The following is a list of ten species of corals that have been found at this horizon in Missouri, Iowa and Illinois, as indicated by Prof. White: *Zephreutis calceola* and *Z. acuta* of White and Whitfield, *Z. elliptica* White, *Chonophyllum Sedaliense* White, *Syringapora harveyu* White, *Favosites (Michelinia) divergens* White, M. *expansa* White, M. *placenta* White, *Lepidopora typa* Winchell, *Lithostrotion Microstylum* White.

Plate 42 is peculiarly interesting to amateur palæontologists of Kansas City, for two very interesting fossils were discovered at Kansas City and are here figured: *Pheurotomaria Broadheadu* White, the largest Pleurotomaria yet described from the coal measures. Smaller specimens of this species have been obtained from Pleasant Hill, Kansas City and from Northwest Missouri, but the typical specimen here figured was obtained from the bluffs of Kansas City. It somewhat resembles P. coxanus M. and W., but is specifically very different. It is a handsome fossil and beautifully ornamented; its full height, eighty-eight millimeters; length of aperture, fifty mm.; breadth of same, forty-nine mm.; full diameter of last volution, including aperture, seventy-five mm.

Another fossil figured here is *Conularia crustrela* White, which has only been found in Missouri in a six-inch stratum at Kansas City; specimens of it can be seen in most cabinets of Kansas City. I have also found it at one locality in Montgomery county, Ill. Prof. White speaks of this fossil also having been obtained by Prof. E. D. Cope, from Taos, New Mexico. It is the only species of *Conularia* at present known from the coal measures of the Mississippi valley, although several species have been obtained from sub-carboniferous rocks.

Another new species of Prof. White is the *Naticopsis Morilifera*, a pretty form from No. 72 of upper coal measures at Pleasant Hill, Mo. I have found it nowhere else.

G. C. BROADHEAD.

THE CARPENTERS' STEEL SQUARE AND ITS USES: By Fred. D. Hodgson. Industrial Publication Company, New York, 1880, pp. 68, 12 mo., 75c.

This little work consists of a description of the square and its uses in

obtaining the lengths and bevels of all kinds of rafters, hips, groins, braces, brackets, purlins, collar beams and jack-rafters; also its application in obtaining the bevels and cuts for hoppers, springs, mouldings, octagons, stairs, diminished stiles, etc. It is illustrated by more than fifty wood cuts, of value to a practical workman, while the explanations and directions, being written by the editor of the *Builder & Woodworker*, are plain and clear. Every good carpenter will at once see that it is a valuable work in his line of business.

SCHOOL AND INDUSTRIAL HYGIENE: By D. F. Lincoln, M. D., Philadelphia. Presley Blakiston, 1880, pp. 152, 12 mo., 50c.

This is the twelfth of the American Health Primers, which have proved so popular and useful during the past year, and it will be found no less valuable to families and teachers than its predecessors. The author, Dr. Lincoln of Boston, occupies the prominent position of chairman of the Department of Health in the American Social Science Association, and writes from long experience and with a thorough acquaintance with his subject. The subject is treated under two separate heads: *School Hygiene*, in which such topics as food and sleep, bodily growth, amount of study, exercise, care of the eyes, model school room, etc., are fully and practically discussed: and *Industrial Hygiene*, under which head are treated the injurious effects of inhaling dusty and poisonous substances, injuries from atmospheric changes, injuries from over use of certain organs, regulation of hours of labor, duration of life in various occupations, etc. As we have said before, regarding other volumes in this series, the money it takes to buy each one is most usefully expended in any household.

THE THEORY OF SOUND IN ITS RELATION TO MUSIC: By Professor Pietro Blaserna, New York: J. Fitzgerald & Co., 1880, pp. 28, 4 to., 15c.

This is number ten of the Humboldt Library, which still maintains its high standing as a popular science serial. The object of Professor Blaserna, who is one of the Faculty of the Royal University of Rome, is stated to be to expound briefly the fundamental principles of the relation of sound to music, and to point out its most important applications. This is an object worthy of the consideration of the lovers of science as well as the lovers of art, and doubtless both classes will profit by a study of the work. It is abundantly illustrated, and is written in a style both lucid and attractive.

THE NATURALIST ON THE RIVER AMAZONS: By Henry Walter Bates, F. L. S., New York: J. Fitzgerald & Co., 1880, 2 vols. quarto, pp. 80, 30c.

Two numbers of the Humboldt Library complete this whole narrative of an eleven years' residence and travel in South America, which, in the usual shape, would fill a good sized volume and cost $2.00. Here we have a lengthy and entertaining account of adventures, habits of insects, animals, sketches of

Brazilian and Indian life, and aspects of nature under the equator, printed in good style and on fair paper, all for thirty cents.

OTHER PUBLICATIONS RECEIVED.

The Protective System; What it costs the farmer: By Graham McAdam, N. Y. The Valley Naturalist, Oct., 1880; published by H. Skaer, St. Louis monthly, $1.50 per annum. The Specialist and Intelligencer, Oct., 1880: Edited by Chas. W. Dulles, M. D., Phila., Pa., monthly, $1.50 per annum, published by Presley Blakiston. A Translation of three treatises of Plotinus from the original Greek, by Thomas M. Johnson, Osceola, Mo. An examination of the Double-Star Measures of the Bedford Catalogue, by S. W. Burnham. Geological Report upon the Mineral Lands of Major R. H. Melton, by Prof. G. C. Broadhead.

EDITORIAL NOTES.

THE thirteenth annual meeting of the Kansas City Academy of Science will be held at Topeka, Thursday and Friday, November 11th and 12th, 1880. The business meeting will be held at 3 o'clock p. m., of the 11th at the office of Dr. A. H. Thompson, No. 237 Kansas avenue, and the other meetings at the Senate chamber of the State House. The railroad ticket agents at Topeka will sell return tickets at reduced rates to persons in attendance who have paid full fare in coming. The usual reduction in hotel rates is expected. President Fairchild will deliver one of the two popular evening lectures; the other being given by Prof. Lovewell, of Washburn College. The present indications are for a session of unusual interest.

THE Bessemer method of dephosphorizing pig iron, in the opinion of some of the ablest metallurgic experts of the day, bids fair to supersede the laborious and unhealthy process of puddling and to materially cheapen finished iron,

PROF. SWIFT, astronomer of the Warner Observatory, at Rochester, N. Y., discovered another large comet on the evening of October 10th. The fact was noted in the associated press dispatches, but some important and interesting details which could not be telegraphed are herewith given. The new celestial visitor is in the Constellation of Pegasus, right ascension, 21 hours, 30 minutes, declination north 17 degrees, 30 minutes. Its rate of motion is quite slow, being in a northwesterly direction, so that it is approaching the sun. It has a very strong condensation on one side of the center, in addition to a star-like nucleus, which indicates that it is throwing off an extended tail. From the fact of its extraordinary size, we are warranted in presuming that it will be very brilliant, and the additional fact that it is coming almost directly toward the earth, gives good promise that it will be one of the most remarkable comets of the present century. This is the fifth comet which Prof. Swift has discovered, and the increased facilities which Mr. H. H. Warner, the popular and wealthy medicine man, has given him, by erecting a magnificent observatory for his benefit, promise much more for the future. There is a possibility that further developments may prove this to be the great comet of 1812,

which is being constantly expected, in which event astronomers will have an unusual opportunity to test the spectroscope for the first time upon these eccentric bodies, and ascertain certainly what they are.

THE Boston *Journal of Commerce* says: "The KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY, with its original papers, selections and communications upon various topics, is one of the best filled magazines in its specialty in this country."

WE are indebted to the well known publishing house of Belford, Clarke & Co., of Chicago, for the loan of the cut of the Pueblo village at Taos, New Mexico, shown on page 421 of this number of the REVIEW.

ITEMS FROM THE PERIODICALS.

PATRONS of the REVIEW desiring to subscribe for any of the leading scientific or literary periodicals of this country or Europe can obtain them at reduced prices through this office.

HARPER'S MAGAZINE enters upon its sixty-second volume with the December number. During all those years it has been the most popular periodical of its class, having sometimes reached a circulation of 135,000 copies and never fallen below 100,000. It has grown with the growth of the literature and art of the last thirty years on both sides of the Atlantic; so much so that hereafter it will be published in London as well as in New York. It seems that it has almost reached perfection in the work of its writers, artists and printers, and that it is an indispensable thing to the general reading public.

SUBSCRIBERS of the REVIEW can obtain it through this office at reduced rates.

ONE of the most apropos and practical articles in *Van Nostrand's Magazine* for November is that of Dr. Henry Wurtz, on "Fuel, Gas and the Stong Water Gas System." This magazine continues to be the organ of the engineering fraternity and is deservedly popular with them all.

THE *Literary World*, published in Boston, has almost finished its eleventh volume, and as a critical reviewer of current literature, has no superior in its class. Besides this it is handsome, well printed, carefully edited periodical which is a welcome visitor wherever it is received.

IN the *North American Review* for November we find, in addition to the "Discussion of the Political Situation," by some of the best financiers of the country, the third article, by M. Charnay, upon the "Ruins of Central America; the Nicaragua Route to the Pacific," by Rear Admiral Ammen, and one by Rev. Howard Crosby on the "Coming Revision of the Bible."

THE *Atlantic Monthly* has two articles of scientific character, in addition to the usual interesting table of contents, viz.: "The Silk Industry of the United States," by S. J. Barrows, and "The Future of Weather Foretelling," by Prof. N. S. Shaler.

THE *American Antiquarian* commences its third volume with the October number, the leading article of which is on "Emblematic Mounds, and the Totem system of the Indian Tribes," by the accomplished editor, Dr. S. D. Peet. It is well filled with archæological articles from some of the best writers in the country, and is deserving of the most liberal patronage.

POPULAR SCIENCE MONTHLY presents an unusually full and varied list of articles in its initial number of the eighteenth volume, from the pens of such scientists as Prof. C. A. Young, B. F. De Costa, Dr. Gardner, Professor Alfred B. Mayer, Herbert Spencer, etc., etc.

THE November numbers of *The American Journal of Science and Art* and the *Journal of the Franklin Institute* have not yet been received. They will, with several more of our valued exchanges, be fully noticed next month.